The EPA Administrator signed the following proposed rule on April 15, 2003. It is being submitted for publication in the *Federal Register*. While EPA has taken steps to ensure the accuracy of this Internet version of the rule, it is not the official version of the rule for purposes of public comment. Please refer to the official version in a forthcoming *Federal Register* publication and on GPO's Web Site. The rule will likely be published in the *Federal Register* by the end of May 2003. You can access the *Federal Register* at: http://www.access.gpo.gov/su_docs/aces/aces140.html. When using this site, note that "text" files may be incomplete because they don't include graphics. Instead, select "Adobe Portable Document File" (PDF) files.

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 69, 80, 89, 1039, 1065, and 1068

[AMS-FRL-]
RIN 2060-AK27

Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of Proposed Rulemaking.

SUMMARY: Nonroad diesel engines contribute considerably to our nation's air pollution. These engines, used primarily in construction, agricultural, and industrial applications, are projected to continue to contribute large amounts of particulate matter (PM), nitrogen oxides (NOx), and sulfur oxides (SOx), all of which contribute to serious public health problems in the United States. These problems include premature mortality, aggravation of respiratory and cardiovascular disease, aggravation of existing asthma, acute respiratory symptoms, chronic bronchitis, and decreased lung function. We believe that diesel exhaust is likely to be carcinogenic to humans by inhalation.

Today EPA is proposing new emission standards for nonroad diesel engines and sulfur reductions in nonroad diesel fuel that will dramatically reduce emissions attributed to nonroad diesel engines. This comprehensive national program will regulate nonroad diesel engines and diesel fuel as a system. New engine standards will begin to take effect in the 2008 model year. These standards are based on the use of advanced exhaust emission control devices. We estimate PM reductions of 95%, NOx reductions of 90%, and the virtual elimination of sulfur oxides (SOx) from nonroad engines meeting the new standards. Nonroad diesel fuel sulfur reductions of up to 99% from existing levels will provide significant health benefits as well as facilitate the introduction of high-efficiency catalytic exhaust emission control devices as these devices are damaged by sulfur. These fuel controls would begin in mid-2007. Today's nonroad proposal is largely based on EPA's 2007 highway diesel program.

To better ensure the benefits of the standards are realized in-use and throughout the useful life of these engines, we are also proposing new test procedures, including not-to-exceed requirements, and related certification requirements. The proposal also includes provisions to facilitate the transition to the new engine and fuel standards and to encourage the early introduction of clean technologies and clean nonroad diesel fuel. We have also developed

provisions for both the proposed engine and fuel programs designed to address small business considerations.

The requirements in this proposal would result in substantial benefits to public health and welfare and the environment through significant reductions in emissions of NOx and PM, as well as nonmethane hydrocarbons (NMHC), carbon monoxide (CO), sulfur oxides (SOx) and air toxics. We project that by 2030, this program would reduce annual emissions of NOx, and PM by 827,000 and 127,000 tons, respectively. These emission reductions would prevent 9,600 premature deaths, over 8,300 hospitalizations, and almost a million work days lost, and other quantifiable benefits every year. All told the benefits of this rule would be approximately $81 billion annually by 2030. Costs for both the engine and fuel requirements would be many times less, at approximately $1.5 billion annually.

DATES: *Comments*: Send written comments on this proposal by **August 20, 2003**. See Section IX for more information about written comments.

Hearings: We will hold public hearings on the following dates: **June 10, 2003; June 12, 2003; and June 17, 2003**. Each hearing will start at **9:00 a.m.** local time. If you want to testify at a hearing, notify the contact person listed below at least ten days before the hearing. See Section IX for more information about public hearings.

ADDRESSES: *Comments*: Comments may be submitted electronically, by mail, by facsimile, or through hand delivery/courier. Follow the detailed instructions as provided in Section IX of the **SUPPLEMENTARY INFORMATION** section.

Hearings: We will hold public hearings at the following three locations:

New York, New York Park Central New York 870 Seventh Avenue at 56th Street New York, NY 10019 Telephone: (212) 247-8000 Fax: (212) 541-8506	June 10, 2003
Chicago, Illinois Hyatt Regency O'Hare 9300 W. Bryn Mawr Avenue Rosemont, IL 60018 Telephone: (847) 696-1234 Fax: (847) 698-0139	June 12, 2003

Los Angeles. California Hyatt Regency Los Angeles 711 South Hope Street Los Angeles, California, USA. 90017 Telephone: (213) 683-1234 Fax: (213) 629-3230	June 17, 2003

See Section IX, "Public Participation" below for more information on the comment procedure and public hearings.

FOR FURTHER INFORMATION CONTACT: U.S. EPA, Office of Transportation and Air Quality, Assessment and Standards Division hotline, (734) 214-4636, asdinfo@epa.gov. Carol Connell, (734) 214-4349; connell.carol@epa.gov.

SUPPLEMENTARY INFORMATION:

Regulated Entities

This action would affect you if you produce or import new heavy-duty diesel engines which are intended for use in nonroad vehicles such as agricultural and construction equipment, or produce or import such nonroad vehicles, or convert heavy-duty vehicles or heavy-duty engines used in nonroad vehicles to use alternative fuels. It would also affect you if you produce, import, distribute, or sell nonroad diesel fuel, or sell nonroad diesel fuel.

The following table gives some examples of entities that may have to follow the regulations. But because these are only examples, you should carefully examine the regulations in 40 CFR parts 80, 89, 1039, 1065, and 1068. If you have questions, call the person listed in the FOR FURTHER INFORMATION CONTACT section of this preamble:

Category	NAICS codes[a]	SIC codes[b]	Examples of potentially regulated entities
Industry.....	333618	3519	Manufacturers of new nonroad diesel engines
Industry.....	333111	3523	Manufacturers of farm machinery and equipment
Industry.....	333112	3524	Manufacturers of lawn and garden tractors (home)
Industry.....	333924	3537	Manufacturers of industrial trucks
Industry.....	333120	3531	Manufacturers of construction machinery
Industry.....	333131	3532	Manufacturers of mining machinery and equipment
Industry.....	333132	3533	Manufacturers of oil and gas field machinery and equipment
Industry.....	811112 811198	7533 7549	Commercial importers of vehicles and vehicle components
Industry.....	324110	2911	Petroleum refiners
Industry.....	422710 422720	5171 5172	Diesel fuel marketers and distributors
Industry.....	484220 484230	4212 4213	Diesel fuel carriers

[a] North American Industry Classification System (NAICS).
[b] Standard Industrial Classification (SIC) system code.

How Can I Get Copies of This Document and Other Related Information?

Docket. EPA has established an official public docket for this action under Docket ID No. A-2001-28. The official public docket consists of the documents specifically referenced in this action, any public comments received, and other information related to this action. Although a part of the official docket, the public docket does not include Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. The official public docket is the collection of materials that is available for public viewing at the Air Docket in the EPA Docket Center, (EPA/DC) EPA West, Room B102, 1301 Constitution Ave., NW, Washington, DC. The EPA Docket Center Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Reading Room is (202) 566-1742, and the telephone number for the Air Docket is (202) 566-1742).

Electronic Access. You may access this Federal Register document electronically through the EPA Internet under the "Federal Register" listings at http://www.epa.gov/fedrgstr/.

An electronic version of the public docket is available through EPA's electronic public docket and comment system, EPA Dockets. You may use EPA Dockets at http://www.epa.gov/edocket/ to submit or view public comments, access the index listing of the contents of the official public docket, and to access those documents in the public docket that are available electronically. Once in the system, select "search," then key in the appropriate docket identification number.

Certain types of information will not be placed in the EPA Dockets. Information claimed as CBI and other information whose disclosure is restricted by statute, which is not included in the official public docket, will not be available for public viewing in EPA's electronic public docket. EPA's policy is that copyrighted material will not be placed in EPA's electronic public docket but will be available only in printed, paper form in the official public docket. To the extent feasible, publicly available docket materials will be made available in EPA's electronic public docket. When a document is selected from the index list in EPA Dockets, the system will identify whether the document is available for viewing in EPA's electronic public docket. Although not all docket materials may be available electronically, you may still access any of the publicly available docket materials through the docket facility identified in Section IX.

For public commenters, it is important to note that EPA's policy is that public comments, whether submitted electronically or in paper, will be made available for public viewing in EPA's electronic public docket as EPA receives them and without change, unless the comment contains copyrighted material, CBI, or other information whose disclosure is restricted by statute. When EPA identifies a comment containing copyrighted material, EPA will provide a reference to that material in the version of the comment that is placed in EPA's electronic public docket. The entire printed comment, including the copyrighted material, will be available in the public docket.

Public comments submitted on computer disks that are mailed or delivered to the docket will be transferred to EPA's electronic public docket. Public comments that are mailed or delivered to the Docket will be scanned and placed in EPA's electronic public docket. Where practical, physical objects will be photographed, and the photograph will be placed in EPA's electronic public docket along with a brief description written by the docket staff.

For additional information about EPA's electronic public docket visit EPA Dockets online or see 67 FR 38102, May 31, 2002.

Outline of This Preamble

I. Overview

Nonroad diesel engines are the largest remaining contributor to the overall mobile source emissions inventory. We have already taken steps to dramatically reduce emissions from light-duty vehicles and heavy-duty vehicles and engines through the Tier 2 and 2007 highway diesel programs.[1] With expected growth in the nonroad sector, the relative emissions contribution from nonroad diesel engines is projected to be even larger in future years. This proposed rule sets out emissions standards for nonroad diesel engines used mainly in construction, agricultural, industrial, and mining operations that will achieve reductions in PM and NOx emissions levels

[1] See 65 FR 6698 (February 10, 2000) and 66 FR 5001 (January 18, 2001) for the final rules regarding the Tier 2 and 2007 highway diesel programs, respectively.

from today's engines in excess of 95% and 90%, respectively. Nonroad diesel fuel is currently unregulated. This proposal represents the first time nonroad diesel fuel will be regulated. We are proposing to reduce sulfur levels in nonroad diesel fuel by more than 99 percent to 15 parts per million (ppm). Taken together, controls included in this proposal would result in large public health and welfare benefits.

The proposed standards for nonroad diesel engines and sulfur reductions for nonroad diesel fuel represent a dramatic step in emissions control, based on the use of advanced emissions control technology. Until the mid-90's, these engines had no emissions requirements. As a comparison, cars and trucks have been subject to a series of increasingly stringent emissions control programs since the 1970s. In terms of fuel quality requirements, nonroad diesel fuel is currently uncontrolled at the federal level. EPA has already issued rules ending these disparities for diesel engines used in highway applications. Starting in 2007, these engines will meet standards of the same level of stringency as comparable gasoline vehicles, based on the use of advanced aftertreatment technologies and ultra low sulfur diesel fuel (containing no more than 15 ppm sulfur). This proposal is largely based on the performance of the same advanced aftertreatment technologies, and would bring nonroad diesel fuel to the same 15 ppm cap for sulfur that will be required for highway diesel fuel starting in 2006. We believe it is highly appropriate to propose dramatic steps forward in emissions standards and reductions in sulfur levels in nonroad diesel fuel. As discussed throughout this proposal, such steps represent a feasible progression in the application of advanced emissions control technologies, would achieve needed production of low sulfur diesel fuel to enable the advanced emission control technologies, the standards are cost-effective, and provide very large public health and welfare benefits.

We followed certain principles when developing the elements of this proposal. First, the program must achieve reductions in NOx, SOx, and PM emissions as early as possible. This includes reductions from the in-use fleet of nonroad diesel engines. Second, as we did in the 2007 highway diesel program, we are treating vehicles and fuels as a system since we believe this is the best way to achieve the greatest emissions reductions. Third, the implementation of low sulfur requirements for nonroad diesel fuel must in no way interfere with the implementation and expected benefits of introducing ultra low sulfur fuel in the highway market, as required by the 2007 highway diesel program. Lastly, the program must provide sufficient lead time to allow the integration of advanced emissions control technologies from the highway sector onto nonroad diesel engines as well as the expansion of ultra low sulfur fuel production to the nonroad market.

This proposal sets out new engine exhaust emissions standards, emissions test procedures, including not-to-exceed requirements, for nonroad engines, and sulfur control requirements for nonroad, locomotive, and marine diesel fuel. The proposed exhaust standards would result in particulate matter (PM) and nitrogen oxide (NOx) emissions levels that are in excess of 95 percent and 90 percent, respectively, below comparable levels in effect today. They will begin to take effect in the 2008 model year, with a phase-in of standards across five different engine power rating groupings. New engine emissions test procedures are proposed to take effect with these new standards to better ensure emissions control over real-world engine operation and to help provide for effective compliance determination. Diesel fuel used in nonroad, locomotive, and marine applications would meet a 500 ppm cap starting in June, 2007, a reduction of approximately 90%. There are large benefits to taking this first sulfur reduction action, especially in the reduction of particulate matter from the in-use fleet. In 2010, sulfur levels in nonroad diesel fuel (though not locomotive or marine diesel fuel) would meet a 15 ppm cap, for a total reduction of over 99%. While there are important health and welfare benefits associated with the reduction from 500 ppm to 15 ppm, the main benefit will be to facilitate the introduction of advanced aftertreatment devices on nonroad engines, which would in turn lead to significant benefits. We are also seeking comment on and seriously considering applying the 15 ppm cap to locomotive and marine diesel fuel.

The requirements in this proposal would result in substantial benefits to public health and welfare and the environment through significant reductions in emissions of NOx and PM, as well as nonmethane hydrocarbons (NMHC), carbon monoxide (CO), sulfur oxides (SOx) and air toxics. We project that by 2030, this program would reduce annual emissions of NOx, and PM by 827,000, and 127,000 tons, respectively. These annual emission reductions would prevent 9,600 premature deaths, over 8,300 hospitalizations, and almost a million work days lost, among quantifiable benefits. The overall quantifiable benefits of this rule would be approximately $81 billion annually by 2030. Costs for both the engine and fuel requirements would be significantly less, at approximately $1.5 billion annually.

A. What is EPA Proposing?

This proposal is a further step in EPA's long-term program to control emissions from nonroad diesel engines. The EPA has taken measures to reduce harmful emissions from nonroad diesel engines in two past regulatory actions. A 1994 final rule, developed under provisions of Section 213 of the Clean Air Act, set initial emissions standards for new nonroad diesel engines greater than 50 hp (59 FR 31306, June 17, 1994). These standards gained modest reductions in NOx emissions and are referred to as EPA's "Tier 1" standards for large nonroad engines. A subsequent final rule published in 1998 set more stringent Tier 2 and Tier 3 standards for these engines, as well as Tier 1 and Tier 2 standards for the nonroad diesel engines under 50 hp (63 FR 56968, October 23, 1998). Nonroad diesel fuel quality is not presently regulated by the EPA.

We also expressed our intent in the 1998 final rule to continue evaluating the rapidly changing state of diesel emissions control technology, and to perform a review in the 2001 timeframe of the technological feasibility of the Tier 3 standards, and of the Tier 2 standards for engines rated under 50 hp. This review was completed in 2001 and documented in an EPA staff technical paper that confirmed the feasibility of those standards, finding that the number of potential control options had expanded since the 1998 final rule to include new technologies and more effective application of existing technologies.[2]

[2] "Nonroad Diesel Emissions Standards Staff Technical Paper", EPA420-R-01-052, October 2001.

There are two basic parts to this proposed program: (1) new exhaust emission standards and test procedures for nonroad diesel engines, and (2) new sulfur limits for nonroad, locomotive, and marine diesel fuel. The systems approach of combining the engine and fuel standards into a single program is critical to the success of our overall efforts to reduce emissions, because the emission standards will not be feasible without the fuel change. This proposal is largely based on the 2007 highway diesel program.

We looked at a number of alternative program options, as discussed in more detail in Section VI below and Chapter 12 of the draft Regulatory Impact Analysis (RIA). For example, we analyzed a program that would require refiners to produce 15 ppm nonroad diesel fuel starting in 2008, with appropriate engine standards phased-in beginning in 2009. Many of these alternatives provided a very similar level of projected emissions control and health and welfare benefits as our proposed program. However, taking into account the need for appropriate lead time, achieving the greatest possible emissions reductions as early as possible, and the interaction of requirements in this proposal with existing highway diesel engine environmental programs, we believe our proposed program provides the best opportunity for achieving all of our goals, as described above, including timely and significant emissions reductions from nonroad diesel engines and the associated introduction of ultra low sulfur nonroad diesel fuel. We are asking for comments on the alternatives discussed in this proposal.

The elements of the rule are outlined below. Detailed provisions and justifications for our proposed rule are discussed in subsequent sections and the draft RIA

1. Nonroad Diesel Engine Emission Standards

Today's action proposes standards for nonroad diesel engines ranging from 3 to over 3,000 horsepower. Applicable emissions standards are determined by year for each of five engine power band categories. For engines less than 25 hp, we are proposing new engine standards for PM (0.30 g/bhp-hr) and CO (4.9 g/bhp-hr) to go along with existing NOx standards beginning in 2008. For engines between 25-75 hp, we are proposing standards reflecting approximately 50% reduction in PM control from today's engines applicable in 2008. Then, starting in 2013, PM standards of 0.02 g.bhp-hr and NOx standards of 3.5 g/bhp-hr would apply. For engines between 75-175 hp, the proposed standards would be 0.01 g/bhp-hr for PM, 0.30 g/bhp-hr for NOx, and 0.14 g/bhp-hr for HC beginning in 2012. These same standards would apply for both engines between 175-750 hp and greater than 750 hp starting in 2011. These PM, NOx, and NMHC standards are similar in stringency to the final standards included in the 2007 highway diesel program and are expected to require the use of high-efficiency aftertreatment systems to ensure compliance. Thus, virtually all nonroad diesel engines after 2013 would likely be using advanced aftertreatment systems. We are phasing in many of these proposed standards over a period of three years in order to address lead time, workload, and feasibility considerations.

We are also proposing to continue the averaging, banking, and trading nonroad emissions credits provisions to demonstrate compliance with the standards. In addition, we are proposing to include turbocharged diesels in the existing prohibition on crankcase emissions, effective in the same year that the proposed Tier 4 standards first apply in each power category. More specific information on the proposed standards can be found in Section III below.

To better ensure the benefits of the standards are realized in-use and throughout the useful life of these engines, we are also proposing new test procedures and related certification requirements. We believe the new supplemental transient test, Constant Speed Variable Load transient duty cycle, cold start transient test, and not-to-exceed test procedures and standards will all help achieve our goal. This is a significant and important aspect of this proposal that would bring greater confidence and certainty to the compliance program.

The proposal also includes provisions to facilitate the transition to the new engine and fuel standards and to encourage the early introduction of clean technologies. We are also including proposed adjustments to various fuel and engine testing and compliance requirements. These provisions are described further in Sections III, IV, and VI.

2. Nonroad, Locomotive, and Marine Diesel Fuel Quality Standards

We are proposing that sulfur levels for nonroad diesel fuel be reduced from current uncontrolled levels ultimately to 15 ppm, though we are proposing an interim cap of 500 ppm. Beginning June 1, 2007, refiners would therefore be required to produce nonroad, locomotive, and marine diesel fuel that meets a maximum sulfur level of 500 ppm. This does not include diesel fuel for home heating, industrial boiler, or stationary power uses or diesel fuel used in aircraft. We estimate there are significant health and welfare benefits associated with this proposed reduction, including reductions in sulfate emissions and reduced engine operating expenses. Then, beginning in June 1, 2010, fuel used for nonroad diesel applications (excluding locomotive and marine engines) is proposed to meet a maximum sulfur level of 15 ppm, since all 2011 and later model year nonroad diesel-fueled engines with aftertreatment must be refueled with this new ultra low sulfur diesel fuel. This sulfur standard is based on our assessment of the impact of sulfur on advanced exhaust emission control technologies and a corresponding assessment of the feasibility of ultra low sulfur fuel production and distribution. We are also asking for comment on bringing sulfur levels for locomotive and marine fuel to 15 ppm in 2010 and note that we anticipate beginning the process of developing new engine controls for these two sources in 2004. This proposal includes a combination of provisions available to refiners, especially small refiners, to ensure a smooth transition to ultra low sulfur nonroad diesel fuel.

In addition, this proposal includes unique provisions for implementing the ultra low sulfur diesel fuel program in the State of Alaska. We are also proposing that certain U.S. territories be excluded from both the nonroad engine standards and diesel fuel standards. Similar actions were taken as part of the 2007 highway diesel program.

The compliance provisions for ensuring diesel fuel quality are essentially consistent with those that have been in effect since 1993 for highway diesel fuel, reflecting updated requirements that were included in the 2007 highway diesel program. Additional compliance provisions are proposed for the transition years of the program concerning the interaction of the nonroad, locomotive, and marine sulfur control requirements with existing highway diesel sulfur control provisions. These provisions could also help discourage misfueling of nonroad equipment utilizing high-efficiency aftertreatment devices. The proposed compliance requirements include provisions that would prohibit equipment operators from fueling their machines with higher sulfur fuels after completion of the shift to lower sulfur nonroad diesel fuels, regardless of the age of their equipment.

B. Why Is EPA Making This Proposal?

1. Nonroad, Locomotive, and Marine Diesels Contribute to Serious Air Pollution Problems

As discussed in detail in Section II and Chapter 2 and 3 of draft RIA, emissions from nonroad, locomotive, and marine diesel engines contribute greatly to a number of serious air pollution problems, and these emissions would have continued to do so into the future absent further controls to reduce them. First, these engines contribute to the health and welfare effects associated with ozone, PM, NOx, SOx, and volatile organic compounds (VOCs), including toxic compounds such as formaldehyde. These adverse effects include premature mortality, aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions and emergency room visits, school absences, work loss days, and restricted activity days), changes in lung function and increased respiratory symptoms, changes to lung tissues and structures, altered respiratory defense mechanisms, chronic bronchitis, and decreased lung function.[3] [4] [5] Second and importantly, in addition to its contribution to ambient PM inventories, diesel exhaust is of specific concern because it has been judged to likely pose a lung cancer hazard for humans as well as a hazard from noncancer respiratory effects. The Agency has classified diesel exhaust as likely to be carcinogenic to humans by inhalation at environmental exposures. Third, ozone and PM cause significant public welfare harm. Specifically, ozone causes damage to vegetation which leads to economic crop and forestry losses, as well as harm to national parks, wilderness areas, and other natural systems. PM causes damage to materials and soiling of commonly used building materials and culturally important items such as statues and works of art. Fourth, NOx, SOx and direct emissions of PM contribute to substantial visibility

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[3] U.S. EPA (1996) Air Quality Criteria for Particulate Matter - Volumes I, II, and III, EPA Office of Research and Development, National Center for Environmental Assessment, July 1996. Report No. EPA/600/P-95/001aF, EPA/600/P-95/001bF, EPA/600/P-95/001cF.

[4] U.S. EPA (2002), Air Quality Criteria for Particulate Matter - Volumes I and II (Third External Review Draft). This material is available electronically at http://cfpub.epa.gov/ncea/cfm/partmatt.cfm.

[5] U.S. EPA (1996) Air Quality Criteria for Ozone and Related Photochemical Oxidants. EPA Office of Research and Development, National Center for Environmental Assessment, July 1996. Report No. EPA/600/P-93/004aF. The document is available on the internet at http://www.epa.gov/ncea/ozone.htm.

impairment in many parts of the U.S. where people live, work, and recreate, including mandatory Federal Class I areas. Finally, NOx emissions from nonroad diesel engines contribute to the acidification, nitrification and eutrophication of water bodies.

Millions of Americans live in areas with unhealthful air quality that may endanger public health and welfare (i.e., levels not requisite to protect the public health with an adequate margin of safety). Based upon data for 1999 - 2001, there are 291 counties that are violating the 8-hour ozone NAAQS, totaling 111 million people. In addition, at least 65 million people in 129 counties live in areas where annual design values of ambient $PM_{2.5}$ violate the $PM_{2.5}$ NAAQS. There are an additional 9 million people in 20 counties where levels above the $PM_{2.5}$ NAAQS are being measured, but the data are incomplete. Without emission reductions from the proposed new standards for nonroad engines, there is a significant future risk that 32 counties with 47 million people across the country may violate the 8-hour ozone national ambient air quality standard (NAAQS) in 2030, based on our modeling. Similarly, modeled $PM_{2.5}$ concentrations in 107 counties where 85 million people live are above specified levels in 2030. An additional 64 million people are projected to live in counties within 10 percent of the $PM_{2.5}$ standard in 2030, and 44 million people are projected to live in counties within 10 percent of the level of the 8-hour standard in 2030. Thus, our analyses show that these counties face a significant risk of exceeding or failing to maintain the $PM_{2.5}$ and the 8-hour ozone NAAQS without significant additional controls between 2007 and 2030.

Federal, state and local governments are working to bring ozone and particulate levels into compliance with the NAAQS through State Implementation Plan (SIP) attainment and maintenance plans, and to ensure that future air quality reaches and continues to achieve these health- and welfare-based standards. The reductions in this proposed rulemaking will play a critical part in these important efforts to attain and maintain the NAAQS. In addition, reductions from this action will also reduce public health and welfare effects associated with maintenance of the 1-hour ozone and PM_{10} NAAQS.

Emissions from nonroad, locomotive, and marine diesel engines account for substantial portions of the country's ambient PM and NOx levels. NOx is a key precursor to ozone and PM formation. We estimate that these engines account for about ten percent of total NOx emissions and about ten percent of total PM emissions. These proportions are even higher in some urban areas, where these engines contribute up to 19 percent of the total NOx emissions and up to 18 percent of the total PM emissions inventory. Over time, the relative contribution of these diesel engines to air quality problems will go even higher unless EPA takes action to further reduce pollution levels. For example, EPA has already taken steps to bring emissions levels from light-duty and heavy-duty vehicles and engines to near-zero levels by the end of this decade. The PM and NOx standards for nonroad, locomotive, and marine diesel engines in this proposal would have a substantial impact on emissions. By 2030, NOx emissions from these diesel engines under today's standards will be reduced by 827,000 tons, and PM emissions will decline by about 127,000 tons, dramatically reducing this source of NOx and PM emissions. Urban areas, which include many poorer neighborhoods, can be disproportionately impacted by such diesel emissions, and these neighborhoods will thus receive a relatively larger portion of the benefits expected from proposed emissions controls. Diesel exhaust is of special concern because it is associated with increased risk of lung cancer and respiratory disease. EPA recently issued its

Health Assessment Document for Diesel Exhaust.[6] The Agency has classified diesel exhaust as likely to be carcinogenic to humans by inhalation at environmental exposures. State and local governments, in their efforts to protect the health of their citizens and comply with requirements of the Clean Air Act (CAA or "the Act"), have recognized the need to achieve major reductions in diesel PM emissions, and have been seeking Agency action in setting stringent new standards to bring this about.[7]

2. Technology and Fuel Based Solutions

Although the air pollution from nonroad diesel exhaust is challenging, we believe they can be addressed through the application of high-efficiency emissions control technologies. As discussed in much greater detail in Section III, the development of diesel emissions control technology has advanced in recent years so that very large emission reductions (in excess of 90 percent) are possible, especially through the use of catalytic emission control devices installed in the nonroad equipment's exhaust system and integrated with the engine controls. These devices are often referred to as "exhaust emission control" or "aftertreatment" devices. Exhaust emission control devices, in the form of the well-known catalytic converter, have been used in gasoline-fueled automobiles for 28 years.

Based on the Clean Air Act requirements in section 213, we are proposing stringent new emission standards that will result in the use of these diesel exhaust emission control devices. We are also proposing changes to nonroad diesel fuel quality standards, under section 211 (c) of the Act, in order to enable these high-efficiency technologies.

To meet the proposed new standards, application of high-efficiency exhaust emission controls for both PM and NOx will be needed for most engines. High-efficiency PM exhaust emission control technology has been available for several years. This technology has continued to improve over the years, especially with respect to durability and robust operation in use. It has also proved extremely effective in reducing exhaust hydrocarbon emissions. Thousands of such systems are now in use, especially in Europe. It is the same technology we expect to be applied to meet the PM standards in the 2007 heavy-duty highway diesel engine rule. However, as discussed in detail in Section III, these systems are very sensitive to sulfur in the fuel. For the technology to be viable and capable of meeting the standards, we believe it will require diesel fuel with sulfur content capped at the 15 ppm level.

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[6] U.S. EPA (2002) Health Assessment Document for Diesel Engine Exhaust. EPA/600/8-90/057F Office of Research and Development, Washington DC. This document is available electronically at http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060.

[7] For example, see letters dated April 9, 2002 from Agency Secretary of California EPA, Commissioner of NY State DEC, and Commissioner of Texas NRCC to Governor Whitman; dated January 28, 2003 from Western Regional Air Partnership to Governor Whitman, and dated Dec 17, 2002, from State and Territorial Air Pollution Program Administrators and Association of Local Air Pollution Control Officials and Northeast States for Coordinated Air Use Mangement (and other organizations).

Similarly, high-efficiency NOx exhaust emission control technology will be needed if nonroad diesel engines are to attain the proposed standards. This is the same technology that we anticipate will be applied to heavy-duty highway diesel engines to meet the NOx standards included in the 2007 highway diesel program. This technology, like the PM technology, is dependant on the 15 ppm maximum nonroad diesel fuel levels being proposed in this action in order to be feasible and capable of achieving the standards. Similar high-efficiency NOx exhaust emission control technology has been quite successful in gasoline direct injection engines that operate with an exhaust composition fairly similar to diesel exhaust and is expected to be used to meet the 2007 and later heavy-duty highway diesel standards. As discussed in Section III, application of this technology to nonroad diesels has some additional engineering challenges. In that section, we discuss the current status of this technology as well as the major development issues still to be addressed and the development steps that can be taken. With the lead-time available and the introduction of ultra low sulfur nonroad diesel fuel, we are confident the proposed application of this technology to nonroad diesels would proceed at a reasonable rate of progress and will result in systems capable of achieving the standards.

This view is further supported by the fact that manufacturers are already working on developing high-efficiency aftertreatment devices in order to have them available for introduction on highway diesel engines by 2007. EPA issued a progress report in June, 2002 which discussed our findings that industry was making substantial progress in developing these devices. Additionally, the Clean Diesel Independent Review Panel issued a report in October, 2002 on similar questions and concluded that, while technical issues remain, there were no technical hurdles identified that would prevent market introduction of high-efficiency aftertreatment devices on schedule.

The need to reduce sulfur in nonroad diesel fuel is driven by the requirements of the exhaust emission control technology that we project will be needed to meet the proposed standards for most nonroad diesel engines. The challenge in accomplishing the sulfur reduction is driven by the capacity to implement the needed refinery modifications, and by the costs of making the modifications and running the equipment. Today, a number of refiners are acting to provide low sulfur diesel to some markets. We believe that controlling the sulfur content of highway diesel fuel to the 15 ppm level is necessary, feasible, and cost-effective.

Additionally, there are health and welfare benefits associated with the initial step of reducing the sulfur level of nonroad, locomotive, and marine diesel fuel to 500 ppm. This proposed action will provide dramatic, immediate reductions in direct sulfate PM and SO_2 emissions from the in-use fleet. As described in this proposal, we believe this fuel control strategy is a cost-effective air quality solution as well.

3. Basis For Action Under the Clean Air Act

Section 213 of the Act gives us the authority to establish emissions standards for nonroad engines and vehicles. Section 213(a)(3) authorizes the Administrator to set standards for NOx, VOCs, or carbon monoxide, to reduce ambient levels of ozone and carbon monoxide which “standards shall achieve the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the engines or vehicles.” As part of this determination, the Administrator must give appropriate consideration to cost, lead time, noise, energy, and safety factors associated with the application of such technology. Section 213(a)(4) authorizes the Administrator to establish standards to control emissions of pollutants which “may reasonably be anticipated to endanger public health and welfare”. Here, the Administrator may promulgate regulations that are deemed appropriate for new nonroad vehicles and engines which cause or contribute to such air pollution, taking into account costs, noise, safety, and energy factors. EPA believes the proposed controls for PM in today’s rule would be an appropriate exercise of EPA’s discretion under the authority of section 213(a)(4).

We believe the evidence provided in Section III and the Draft Regulatory Impact Analysis (RIA) indicates that the stringent emission standards proposed today are feasible and reflect the greatest degree of emission reduction achievable in the model years to which they apply. We have given appropriate consideration to costs in proposing these standards. Our review of the costs and cost-effectiveness of these standards indicate that they will be reasonable and comparable to the cost-effectiveness of other emission reduction strategies that have been required or could be required in the future. We have also reviewed and given appropriate consideration to the energy factors of this rule in terms of fuel efficiency and effects on diesel fuel supply, production, and distribution, as discussed below, as well as any safety factors associated with these proposed standards.

The information in Section II and Chapter 2 of the draft RIA regarding air quality and the contribution of nonroad, locomotive, and marine diesel engines to air pollution provides strong evidence that emissions from such engines significantly and adversely impact public health or welfare. First, as noted earlier, there is a significant risk that several areas will fail to attain or maintain compliance with the NAAQS for 8-hour ozone concentrations or for PM2.5 concentrations during the period that these new vehicle and engine standards will be phased into the vehicle population, and that nonroad, locomotive, and marine diesel engines contribute to such concentrations, as well as to concentrations of other NAAQS-related pollutants. This risk will be significantly reduced by the standards adopted today, as also noted above. However, the evidence indicates that some risk remains even after the reductions achieved by these new controls on nonroad diesel engines and nonroad, locomotive, and marine diesel fuel. Second, EPA believes that diesel exhaust is likely to be carcinogenic to humans. The risk associated with exposure to diesel exhaust includes the particulate and gaseous components among which are benzene, formaldehyde, acetaldehyde, acrolein, and 1,3-butadiene, all of which are known or suspected human or animal carcinogens, or have serious noncancer health effects. Third, emissions from nonroad diesel engines (including locomotive and marine diesel engines) contribute to regional haze and impaired visibility across the nation, as well as acid deposition, POM deposition, eutrophication and nitrification, all of which are serious environmental welfare problems.

EPA has already found in previous rules that emissions from new nonroad diesel engines contribute to ozone and carbon monoxide (CO) concentrations in more than one area which has failed to attain the ozone and carbon monoxide NAAQS. 59 FR 31306 (June 17, 1994). EPA has also previously determined that it is appropriate to establish standards for PM from new nonroad diesel engines under section 213(a)(4), and the additional information on diesel exhaust carcinogenicity noted above reinforces this finding. In addition, we have already found that emissions from nonroad engines significantly contribute to air pollution that may reasonably be anticipated to endanger public welfare due to regional haze and visibility impairment. 67 FR 68242, 68243 (Nov. 8, 2002). We find here, based on the information in Section II of this preamble and Chapter 2 of the draft RIA, that emissions from the new nonroad diesel engines covered by this proposal likewise contribute to regional haze and to visibility impairment that may reasonably be anticipated to endanger public welfare. Taken together, these findings indicate the appropriateness of the nonroad diesel engine standards proposed today for purposes of section 213(a)(3) and (4) of the Act.

Section 211(c) of the CAA allows us to regulate fuels where emission products of the fuel either: 1) cause or contribute to air pollution that reasonably may be anticipated to endanger public health or welfare, or 2) will impair to a significant degree the performance of any emission control device or system which is in general use, or which the Administrator finds has been developed to a point where in a reasonable time it will be in general use were such a regulation to be promulgated. This rule meets both of these criteria. SOx and sulfate PM emissions from nonroad, locomotive, marine and diesel vehicles are due to sulfur in diesel fuel. As discussed above, emissions of these pollutants cause or contribute to ambient levels of air pollution that endanger public health and welfare. Control of sulfur to 500 ppm for this fuel would lead to significant, cost-effective reductions in emissions of these pollutants. The substantial adverse effect of high sulfur levels on the performance of diesel emission control devices or systems that would be expected to be used to meet the nonroad standards is discussed in detail in Section III. Control of sulfur to 15 ppm in nonroad diesel fuel would enable emissions control technology that will achieve significant, cost-effective reduction in emissions of these pollutants, as discussed in Section II below. In addition, our authority under section 211(c) is discussed in more detail in Appendix A to the draft RIA.

II. What Is the Air Quality Impact of the Sources Covered by the Proposed Rule?

With this proposal, EPA is acting to extend highway types of emission controls to another major source of diesel engine emissions, nonroad diesel engines. These emissions are significant contributors to atmospheric pollution from particulate matter, ozone and a variety of toxic air pollutants. In our most recent nationwide inventory used for this proposal (1996), the nonroad diesels affected by this proposal[8] contribute over 43 percent of diesel PM emissions from mobile sources, up to 18 percent of $PM_{2.5}$ emissions in urban areas, and up to 14 percent of NOx emissions in urban areas.

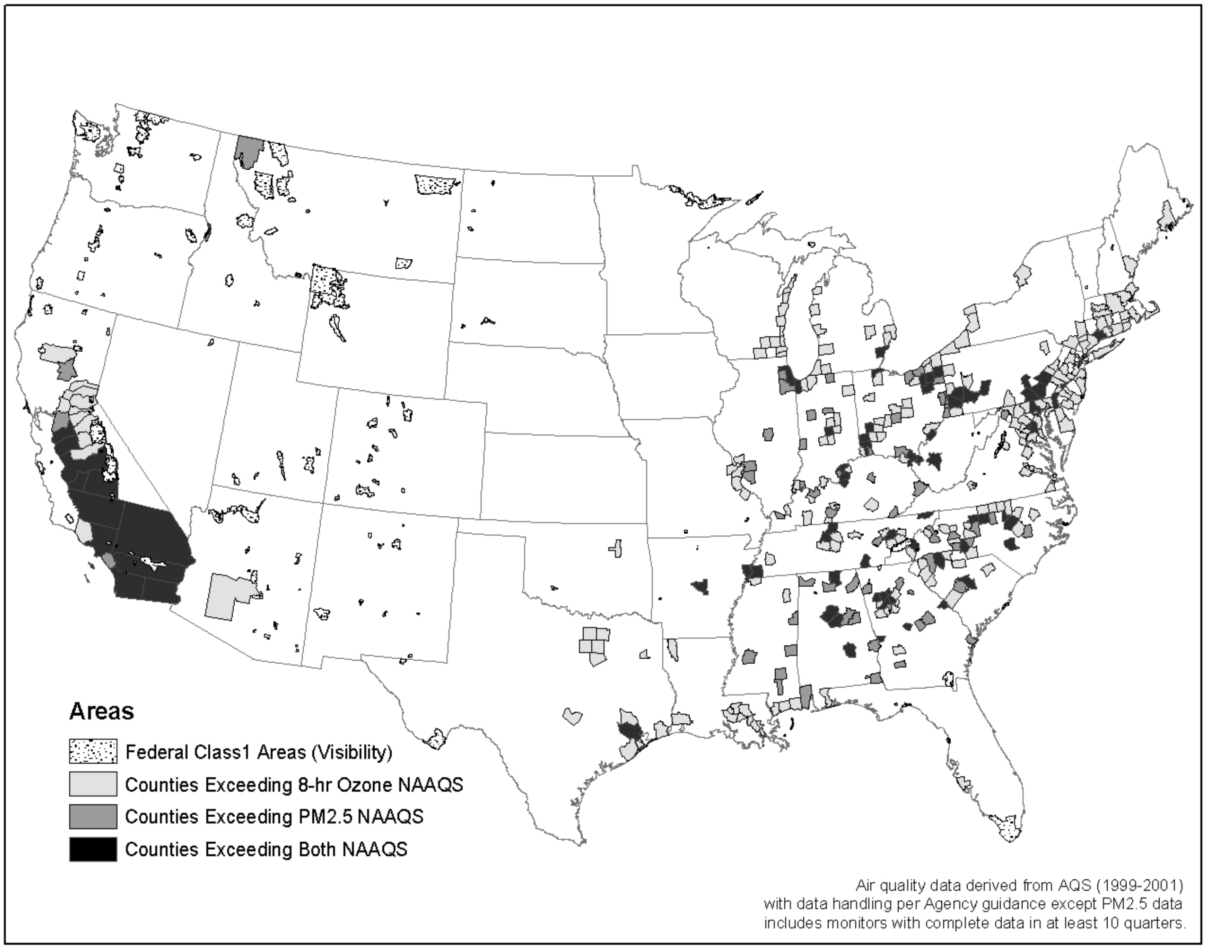
[8] For NOx and $PM_{2.5}$ this includes all land based nonroad diesel engines, but not locomotive, commercial marine vessel, and recreational marine vessel engines. Since the latter three engine categories are affected by the fuel sulfur portions of the proposal, they are included for SO_2.

Without further control beyond those standards we have already adopted, by the year 2020, these engines will emit 62 percent of diesel PM emissions from mobile sources, up to 19 percent of $PM_{2.5}$ emissions in urban areas, and up to 20 percent of NOx emissions in urban areas.

When fully implemented, this proposal would reduce nonroad diesel $PM_{2.5}$ and NOx emissions by more than 90 percent. It will also virtually eliminate nonroad diesel SOx emissions, which amounted to nearly 230,000 tons in 1996, and would otherwise grow to approximately 340,000 tons by 2020.

These dramatic reductions in nonroad emissions are a critical part of the effort by federal, state and local governments to reduce the health related impacts of air pollution and to reach attainment of the NAAQS for PM and ozone, as well as to improve other environmental effects such as atmospheric visibility. Based on the most recent data available for this rule (1999-2001), such problems are widespread in the United States. There are over 65 million people living in counties with monitored $PM_{2.5}$ levels exceeding the $PM_{2.5}$ NAAQS, and 111 million people living in counties with monitored concentrations exceeding the 8hour ozone NAAQS. Figure II.-1 illustrates the widespread nature of these problems. Shown in this figure are counties exceeding either or both of the two NAAQS plus mandatory Federal Class I areas, which have particular needs for reductions in atmospheric haze.

FIGURE II-1 -- AIR QUALITY PROBLEMS ARE WIDESPREAD



As we will describe later in this preamble, the air quality improvements expected from this proposal is anticipated to produce major benefits to human health and welfare, with a combined value in excess of half a trillion dollars between 2007 and 2030. By the year 2030, this proposed rule would be expected to prevent approximately 9,600 deaths per year from premature mortality, and 16,000 nonfatal heart attacks. It is estimated to also prevent 14,000 acute bronchitis attacks in children, 260,000 respiratory symptoms in children, and nearly 1 million lost work days in 2030. The reductions will also improve visibility.

In the remainder of this section we will describe in more detail the air pollution problems associated with emissions from non-road diesel engines, and the emission and air quality benefits we expect to realize from the fuel and engine controls in this proposal.

A. Overview

The emissions from nonroad engines that are being directly controlled by the standards in this rulemaking are NOx, PM and NMHC, and to a lesser extent, CO. Gaseous air toxics from nonroad diesels will also be reduced as a consequence of the proposed standards. In addition there will be a substantial reduction in SOx emissions resulting from the proposed reduction in sulfur level in diesel fuel.

From a public health perspective, we are primarily concerned with nonroad engine contributions to atmospheric levels of particulate matter in general, diesel PM in particular and various gaseous air toxics emitted by diesel engines, and ozone[9]. We will first review important public health effects linked to these pollutants, briefly describing the human health effects and the current and expected future ambient levels of direct or indirectly caused pollution. Our presentation will show that substantial further reductions of these pollutants, and the underlying emissions from nonroad diesel engines, are needed to protect public health.

Following discussion of health effects, we will discuss a number of welfare effects associated with emissions from diesel engines. These effects include atmospheric visibility impairment, ecological and property damage caused by acid deposition, eutrophication and nitrification of surface waters, environmental threats posed by polycyclic organic matter (POM) deposition, and plant and crop damage from ozone. Once again, the information available to us indicates a continuing need for further nonroad emission reductions to bring about improvements in air quality.

Next, we will describe our understanding of the engine emission inventories for the primary pollutants affected by the proposal. As noted above, these include PM, NOx, SOx, Air Toxics and HC. We will present current and projected future levels of emissions for the base case, including anticipated reductions from control programs already adopted by EPA and the States, but without the controls proposed today. Then we will identify expected emission reductions from nonroad engines. These reductions will make important contributions to controlling the health and welfare problems associated with ambient PM and ozone levels and with diesel related air toxics.

While the material we will present in this section will describe our understanding of the need for control of nonroad engine emissions and the air quality improvements we expect to realize, this section is not an exhaustive treatment of these issues. For a fuller understanding of the topics treated here, you should refer to the extended presentations in the Draft Regulatory Impact Analysis accompanying this proposal.

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[9] Ambient particulate matter from nonroad diesel engine is associated with the direct emission of diesel particulate matter, and with particulate matter formed indirectly in the atmosphere by NOx and SOx emissions (and to a lesser extent NMHC emissions). Both NOx and NMHC participate in the atmospheric chemical reactions that produce ozone.

B. Public Health Impacts

1. Particulate Matter

Particulate matter (PM) represents a broad class of chemically and physically diverse substances. It can be principally characterized as discrete particles that exist in the condensed (liquid or solid) phase spanning several orders of magnitude in size. PM_{10} refers to particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers. Fine particles refer to those particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers (also known as $PM_{2.5}$), and coarse fraction particles are those particles with an aerodynamic diameter greater than 2.5 microns, but less than or equal to a nominal 10 micrometers. Ultrafine PM refers to particles with diameters of less than 100 nanometers (0.1 micrometers). The health and environmental effects of PM are associated with fine PM fraction and, in some cases, to the size of the particles. Specifically, larger particles (>10 μm) tend to be removed by the respiratory clearance mechanisms whereas smaller particles are deposited deeper in the lungs. Also, particles scatter light obstructing visibility.

The emission sources, formation processes, chemical composition, atmospheric residence times, transport distances and other parameters of fine and coarse particles are distinct. Fine particles are directly emitted from combustion sources and are formed secondarily from gaseous precursors such as sulfur dioxide (SOx), oxides of nitrogen (NOx), or organic compounds. Fine particles are generally composed of sulfate, nitrate, chloride, ammonium compounds, organic carbon, elemental carbon, and metals. Nonroad diesels currently emit high levels of NOx which react in the atmosphere to form secondary $PM_{2.5}$ (namely ammonium nitrate). Nonroad diesel engines also emit SO_2 and HC which react in the atmosphere to form secondary $PM_{2.5}$ (namely sulfates and organic carbonaceous $PM_{2.5}$). Combustion of coal, oil, diesel, gasoline, and wood, as well as high temperature process sources such as smelters and steel mills, produce emissions that contribute to fine particle formation. In contrast, coarse particles are typically mechanically generated by crushing or grinding. They include resuspended dusts and crustal material from paved roads, unpaved roads, construction, farming, and mining activities. These coarse particles can be either natural in source such as road dust or anthropogenic. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometers, while coarse particles deposit to the earth within minutes to hours and within tens of kilometers from the emission source.

The relative contribution of various chemical components to $PM_{2.5}$ varies by region of the country. Data on $PM_{2.5}$ composition are available from the EPA Speciation Trends Network in 2001 and the **I**nteragency **M**onitoring of **PRO**tected **V**isual **E**nvironments (IMPROVE) network in 1999 covering both urban and rural areas in numerous regions of the U.S. These data show that carbonaceous $PM_{2.5}$ makes up the major component for $PM_{2.5}$ in both urban and rural areas in the western U.S. Carbonaceous $PM_{2.5}$ includes both elemental and organic carbon. Nitrates formed from NOx also play a major role in the western U.S., especially in the California area where it is responsible for about a quarter of the ambient $PM_{2.5}$ concentrations. Sulfate plays a lesser role in these regions. For the eastern and mid U.S., these data show that both sulfates and carbonaceous $PM_{2.5}$ are major contributors to ambient $PM_{2.5}$ in both urban and rural areas. In some eastern areas, carbonaceous $PM_{2.5}$ is responsible for up to half of ambient $PM_{2.5}$ concentrations. Sulfate is also a major contributor to ambient $PM_{2.5}$ in the eastern U.S. and in some areas make greater contributions than carbonaceous $PM_{2.5}$.[10, 11]

Nonroad engines, and most importantly nonroad diesel engines, contribute significantly to ambient $PM_{2.5}$ levels, largely through emissions of carbonaceous $PM_{2.5}$. Carbonaceous $PM_{2.5}$ is a major portion of ambient $PM_{2.5}$, especially in populous urban areas. Nonroad diesels also emit high levels of NOx which react in the atmosphere to form secondary $PM_{2.5}$ (namely nitrate). Nonroad diesels also emit SO_2 and NMHC which react in the atmosphere to form secondary $PM_{2.5}$ (namely sulfates and organic carbonaceous $PM_{2.5}$). For more details, consult the draft RIA for this proposed rule.

Diesel particles from nonroad diesel are a component of both coarse and fine PM, but fall mainly in the fine (and even ultrafine) size range. As discussed later, diesel PM also contains small quantities of numerous mutagenic and carcinogenic compounds associated with the particulate (and also organic gases). In addition, while toxic trace metals emitted by nonroad diesel engines represent a very small portion of the national emissions of metals (less than one percent) and a small portion of diesel PM (generally less than one percent of diesel PM), we note that several trace metals of potential toxicological significance and persistence in the environment are emitted by diesel engines. These trace metals include chromium, manganese, mercury and nickel. In addition, small amounts of dioxins have been measured in highway engine diesel exhaust, some of which may partition into the particulate phase; dioxins through out the environment are a major health concern (although the diesel contribution has not been judged significant at this point). Diesel engines also emit polycyclic organic matter (POM), including polycyclic aromatic hydrocarbons (PAH), which can be present in both gas and particle phases of diesel exhaust. Many PAH compounds are classified by EPA as probable human carcinogens.

For additional, detailed, information on PM beyond that summarized below, see the draft Regulatory Impact Analysis.

a. Health Effects of $PM_{2.5}$ and PM_{10}

Scientific studies show ambient PM (which is attributable to a number of sources, including nonroad diesel) is associated with a series of adverse health effects. These health effects are discussed in detail in the EPA Criteria Document for PM as well as the draft updates

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[10] Rao, Venkatesh; Frank, N.; Rush, A.; and Dimmick, F. (November 13-15, 2002). Chemical speciation of $PM_{2.5}$ in urban and rural areas (November 13-15, 2002) In the Proceedings of the Air & Waste Management Association Symposium on Air Quality Measurement Methods and Technology, San Francisco Meeting.

[11] EPA (2002) Latest Finds on National Air Quality, EPA 454/K-02-001.

of this document released in the past year.[12, 13] In addition, EPA's final "Health Assessment Document for Diesel Engine Exhaust," (the Diesel HAD) also reviews health effects information related to diesel exhaust as a whole including diesel PM, which is one component of ambient PM.[14]

As described in these documents, health effects associated with short-term variation in ambient particulate matter (PM) have been indicated by epidemiologic studies showing associations between exposure and increased hospital admissions for ischemic heart disease, heart failure, respiratory disease, including chronic obstructive pulmonary disease (COPD) and pneumonia. Short-term elevations in ambient PM have also been associated with increased cough, lower respiratory symptoms, and decrements in lung function. Short-term variations in ambient PM have also been associated with increases in total and cardiorespiratory daily mortality. Studies examining populations exposed to different levels of air pollution over a number of years, including the Harvard Six Cities Study and the American Cancer Society Study suggest an association between exposure to ambient $PM_{2.5}$ and premature mortality, including deaths attributed to lung cancer.[15, 16] Two studies further analyzing the Harvard Six Cities Study's air quality data have also established a specific influence of mobile source-related $PM_{2.5}$ on daily mortality[17] and a concentration-response function for mobile source-associated $PM_{2.5}$ and daily mortality.[18] Another recent study in 14 U.S. cities examining the effect of PM_{10} on daily hospital admissions for cardiovascular disease found that the effect of PM_{10} was significantly greater in areas with a larger proportion of PM_{10} coming from motor vehicles, indicating that PM_{10} from these sources may have a greater effect on the toxicity of ambient PM_{10}

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12 U.S. EPA (1996.) Air Quality Criteria for Particulate Matter - Volumes I, II, and III, EPA, Office of Research and Development. Report No. EPA/600/P-95/001a-cF. This material is available electronically at http://www.epa.gov/ttn/oarpg/ticd.html.

13 U.S. EPA (2002). Air Quality Criteria for Particulate Matter - Volumes I and II (Third External Review Draft) This material is available electronically at http://cfpub.epa.gov/ncea/cfm/partmatt.cfm.

14 U.S. EPA (2002). Health Assessment Document for Diesel Engine Exhaust. EPA/600/8-90/057F Office of Research and Development, Washington DC. This document is available electronically at http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060.

15 Dockery, DW; Pope, CA, III; Xu, X; et al. (1993) An association between air pollution and mortality in six U.S. cities. N Engl J Med 329:1753-1759.

16 Pope, CA, III; Thun, MJ; Namboordiri, MM; et al. (1995) Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults. Am J Respir Crit Care Med 151:669-674.

17 Laden F; Neas LM; Dockery DW; et al. (2000) Association of fine particulate matter from different sources with daily mortality in six U.S. cities. Environ Health Perspect 108(10):941-947.

18 Schwartz J; Laden F; Zanobetti A. (2002) The concentration-response relation between PM(2.5) and daily deaths. Environ Health Perspect 110(10): 1025-1029.

when compared with other sources.[19] Additional studies have associated changes in heart rate and/or heart rhythm in addition to changes in blood characteristics with exposure to ambient PM.[20, 21] For additional information on health effects, see the draft RIA.

The health effects of PM_{10} are similar to those of $PM_{2.5}$, since PM_{10} includes all of $PM_{2.5}$ plus the coarse fraction from 2.5 to 10 micrometers in size. EPA is also evaluating the health effects of PM between 2.5 and 10 micrometers in the draft revised Criteria Document. As discussed in the Diesel HAD and other studies, most diesel PM is smaller than 2.5 micrometers.[22] Both fine and coarse fraction particles can enter and deposit in the respiratory system.

In addition to the information in the draft revised Criteria Document, the relevance of health effects associated with on-road diesel engine-generated PM to nonroad applications is supported by the observation in the Diesel HAD that the particulate characteristics in the zone around nonroad diesel engines is likely to be substantially the same as published air quality measurements made along busy roadways.

Of particular relevance to this rule is a recent cohort study which examined the association between mortality and residential proximity to major roads in the Netherlands. Examining a cohort of 55 to 69 year-olds from 1986 to1994, the study indicated that long-term residence near major roads, an index of exposure to primary mobile source emissions (including diesel exhaust), was significantly associated with increased cardiopulmonary mortality.[23] Other studies have shown children living near roads with high truck traffic density have decreased lung function and greater prevalence of lower respiratory symptoms compared to children living on other roads.[24] A recent review of epidemiologic studies examining associations between asthma and roadway proximity concluded that some coherence was evident in the literature, indicating that asthma, lung function decrement, respiratory symptoms, and other respiratory problems

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[19] Janssen NA; Schwartz J; Zanobetti A.; et al. (2002) Air conditioning and source-specific particles as modifiers of the effect of PM_{10} on hospital admissions for heart and lung disease. Environ Health Perspect 110(1):43-49.

[20] Pope CA III, Verrier RL, Lovett EG; et al. (1999) Heart rate variability associated with particulate air pollution. Am Heart J 138(5 Pt 1):890-899.

[21] Magari SR, Hauser R, Schwartz J; et al. (2001) Association of heart rate variability with occupational and environmental exposure to particulate air pollution. Circulation 104(9):986-991.

[22] U.S. EPA (1985). Size specific total particulate emission factor for mobile sources. EPA 460/3-85-005. Office of Mobile Sources, Ann Arbor, MI.

[23] Hoek, G; Brunekreef, B; Goldbohm, S; et al. (2002) Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. Lancet 360(9341):1203-1209.

[24] Brunekreef, B; Janssen NA; de Hartog, J; et al. (1997) Air pollution from traffic and lung function in children living near motor ways. Epidemiology (8): 298-303.

appear to occur more frequently in people living near busy roads.[25] As discussed later, nonroad diesel engine emissions, especially particulate, are similar in composition to those from highway diesel vehicles. Although difficult to associate directly with $PM_{2.5}$, these studies indicate that direct emissions from mobile sources, and diesel engines specifically, may explain a portion of respiratory health effects observed in larger-scale epidemiologic studies. Recent studies conducted in Los Angeles have illustrated that a substantial increase in the concentration of ultrafine particles is evident in locations near roadways, indicating substantial differences in the nature of PM immediately near mobile source emissions.[26]

Also, as discussed in more detail later, in addition to its contribution to ambient PM inventories, diesel PM is of special concern because diesel exhaust has been associated with an increased risk of lung cancer. As also discussed later in more detail, we concluded that diesel exhaust ranks with other substances that the national-scale air toxics assessment suggests pose the greatest relative risk.

b. Current and Projected Levels

There are NAAQS for both PM_{10} and $PM_{2.5}$. Violations of the annual $PM_{2.5}$ standard are much more widespread than are violations of the PM_{10} standards. Emission reductions needed to attain the $PM_{2.5}$ standards will also assist in attaining and maintaining compliance with the PM_{10} standards. Thus, since most PM emitted by diesel nonroad engines is fine PM, the emission controls proposed today should contribute to attainment and maintenance of the existing PM NAAQS. More broadly, the proposed standards will benefit public health and welfare through reductions in direct diesel PM and reductions of NOx, SOx, and NMHCs which contribute to secondary formation of PM. The reductions from these proposed rules will assist States as they implement local controls as needed to help their areas attain and maintain the standards.

i. PM_{10} Levels

The current NAAQS for PM_{10} were established in 1987. The primary (health-based) and secondary (public welfare based) standards for PM_{10} include both short- and long-term NAAQS. The short-term (24 hour) standard of 150 ug/m^3 is not to be exceeded more than once per year on average over three years. The long-term standard specifies an expected annual arithmetic mean not to exceed 50 ug/m^3 averaged over three years.

Currently, 29 million people live in PM_{10} nonattainment areas. There are currently 58 moderate PM_{10} nonattainment areas with a total population of 6.8 million. The attainment date for the initial moderate PM_{10} nonattainment areas, designated by operation of law on November

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[25] Delfino RJ. (2002) Epidemiologic evidence for asthma and exposure to air toxics: linkages between occupational, indoor, and community air pollution research. Env Health Perspect Suppl 110(4): 573-589.

[26] Yifang Zhu, William C. Hinds, Seongheon Kim, Si Shen and Constantinos Sioutas
Zhu Y; Hinds WC; Kim S; et al. (2002) Study of ultrafine particles near a major highway with heavy-duty diesel traffic. Atmos Environ 36(27): 4323-4335.

15, 1990, was December 31, 1994. Several additional PM_{10} nonattainment areas were designated on January 21, 1994, and the attainment date for these areas was December 31, 2000. There are an additional 8 serious PM_{10} nonattainment areas with a total affected population of 22.7 million. According to the Act, serious PM_{10} nonattainment areas must attain the standards no later than 10 years after designation. The initial serious PM_{10} nonattainment areas were designated January 18, 1994 and had an attainment date set by the Act of December 31, 2001. The Act provides that EPA may grant extensions of the serious area attainment dates of up to 5 years, provided that the area requesting the extension meets the requirements of Section 188(e) of the Act. Four serious PM_{10} nonattainment areas (Phoenix, Arizona; Coachella Valley, South Coast (Los Angeles), and Owens Valley, California) have received extensions of the December 31, 2001 attainment date and thus have new attainment dates of December 31, 2006.[27] While all of these areas are expected to be in attainment before the emission reductions from this proposed rule are expected to occur, these reductions will be important to assist these areas in maintaining the standards.

ii. $PM_{2.5}$ Levels

The need for reductions in the levels of $PM_{2.5}$ is widespread. Figure II-1 at the beginning of this air quality section highlighted monitor locations measuring concentrations above the level of the NAAQS. As can be seen from that figure, high ambient levels are widespread throughout the country.

The NAAQS for $PM_{2.5}$ were established by EPA in 1997 (62 Fed. Reg., 38651, July 18, 1997). The short term (24-hour) standard is set at a level of 65 $\mu g/m^3$ based on the 98th percentile concentration averaged over three years. (This air quality statistic compared to the standard is referred to as the "design value.") The long-term standard specifies an expected annual arithmetic mean not to exceed 15 ug/m^3 averaged over three years.

Current $PM_{2.5}$ monitored values for 1999-2001, which cover counties having about 75 percent of the country's population, indicate that at least 65 million people in 129 counties live in areas where annual design values of ambient fine PM violate the $PM_{2.5}$ NAAQS. There are an additional 9 million people in 20 counties where levels above the NAAQS are being measured, but there are insufficient data at this time to calculate a design value in accordance with the standard, and thus determine whether these areas are violating the $PM_{2.5}$ NAAQS. In total, this represents 37 percent of the counties and 64 percent of the population in the areas with monitors with levels above the NAAQS. Furthermore, an additional 14 million people live in 41 counties that have air quality measurements within 10 percent of the level of the standard. These areas, although not currently violating the standard, will also benefit from the additional reductions from this rule in order to ensure long term maintenance.

Our air quality modeling performed for this proposal also indicates that similar conditions are likely to continue to exist in the future in the absence of additional controls. For example, in 2020 based on emission controls currently adopted, we project that 66 million people will live in

[27] EPA has also proposed to grant Las Vegas, Nevada, an extension until December 31, 2006.

79 counties with average $PM_{2.5}$ levels above 15 ug/m^3. In 2030, the number of people projected to live in areas exceeding the $PM_{2.5}$ standard is expected to increase to 85 million in 107 counties. An additional 24 million people are projected to live in counties within 10 percent of the standard in 2020, which will increase to 64 million people in 2030.

Our modeling also indicates that the reductions we are expecting will make a substantial contribution to reducing exposures in these areas.[28] In 2020, the number of people living in counties with $PM_{2.5}$ levels above the NAAQS would be reduced from 66 million to 60 million living in 67 counties, which reflects a reduction of 9 percent in potentially exposed population and 15 percent of the number of counties. In 2030, there would be a reduction from 85 million people to 71 million living in 84 counties. These represent even greater improvements than projected for 2020 (numbers of people potentially exposed down 16 percent and number of counties down 21 percent). Furthermore, our modeling also shows that the emission reductions would assist areas with future maintenance of the standards.

We estimate that the reduction of PM levels expected from this proposed rule would produce nationwide air quality improvements in PM levels. On a population weighted basis, the average change in future year annual averages would be a decrease of 0.33 ug/m^3 in 2020, and 0.46 ug/m^3 in 2030. The reductions are discussed in more detail in Chapter 2 of the draft RIA.

While the final implementation process for bringing the nation's air into attainment with the $PM_{2.5}$ NAAQS is still being completed in a separate rulemaking action, the basic framework is well defined by the statute. EPA's current plans call for designating $PM_{2.5}$ nonattainment areas in late-2004. Following designation, Section 172(b) of the Clean Air Act allows states up to three years to submit a revision to their state implementation plan (SIP) that provides for the attainment of the $PM_{2.5}$ standard. Based on this provision, states could submit these SIPs as late as the end of 2007. Section 172(a)(2) of the Clean Air Act requires that these SIP revisions demonstrate that the nonattainment areas will attain the $PM_{2.5}$ standard as expeditiously as practicable but no later than five years from the date that the area was designated nonattainment. However, based on the severity of the air quality problem and the availability and feasibility of control measures, the Administrator may extend the attainment date "for a period of no greater than 10 years from the date of designation as nonattainment." Therefore, based on this information, we expect that most or all areas will need to attain the $PM_{2.5}$ NAAQS in the 2009 to 2014 time frame, and then be required to maintain the NAAQS thereafter.

Since the emission reductions expected from this proposal would begin in this same time frame, the projected reductions in nonroad emissions would be used by states in meeting the $PM_{2.5}$ NAAQS. States and state organizations have told EPA that they need nonroad diesel engine reductions in order to be able to meet and maintain the $PM_{2.5}$ NAAQS as well as visibility regulations, especially in light of the otherwise increasing emissions from nonroad sources

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[28] The results illustrate the type of PM changes for the preliminary control option, as discussed in the Draft RIA in Section 3.6. The proposal differs from the modeled control case based on updated information; however, we believe that the net results would approximate future emissions, although we anticipate the PM reductions might be slightly smaller.

without more stringent standards. [29, 30, 31] Furthermore, this action would ensure that nonroad diesel emissions will continue to decrease as the fleet turns over in the years beyond 2014; these reductions will be important for maintenance of the NAAQS following attainment. The future reductions are also important to achieve visibility goals, as discussed later.

2. Air Toxics

a. Diesel exhaust

A number of health studies have been conducted regarding diesel exhaust including epidemiologic studies of lung cancer in groups of workers, and animal studies focusing on non-cancer effects specific to diesel exhaust. Diesel exhaust PM (including the associated organic compounds which are generally high molecular weight hydrocarbon types but not the more volatile gaseous hydrocarbon compounds) is generally used as a surrogate measure for diesel exhaust.

i. Potential Cancer Effects of Diesel Exhaust

In addition to its contribution to ambient PM inventories, diesel exhaust is of specific concern because it has been judged to pose a lung cancer hazard for humans as well as a hazard from noncancer respiratory effects.

EPA recently released its "Health Assessment Document for Diesel Engine Exhaust," (the Diesel HAD).[32] There, diesel exhaust was classified as likely to be carcinogenic to humans by inhalation at environmental exposures, in accordance with the revised draft 1996/1999 EPA cancer guidelines. A number of other agencies (National Institute for Occupational Safety and Health, the International Agency for Research on Cancer, the World Health Organization, California EPA, and the US Department of Health and Human Services) have made similar classifications. It should be noted that the conclusions in the Diesel HAD were based on diesel engines currently in use, including nonroad diesel engines such as those found in bulldozers, graders, excavators, farm tractor drivers and heavy construction equipment. As new diesel

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[29] California Air Resources Board and New York State Department of Environmental Conservation (April 9, 2002), Letter to EPA Administrator Christine Todd Whitman.

[30] State and Territorial Air Pollution Program Administrators (STAPPA) and Association of Local Air Pollution Control Officials (ALAPCO) (December 17, 2002), Letter to EPA Assistant Administrator Jeffrey R. Holmstead.

[31] Western Regional Air Partnership (WRAP) (January 28, 2003), Letter to Governor Christine Todd Whitman.

[32] U.S. EPA (2002). Health Assessment Document for Diesel Engine Exhaust. EPA/600/8-90/057F Office of Research and Development, Washington DC. This document is available electronically at http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060.

engines with significantly cleaner exhaust emissions replace existing engines, the conclusions of the Diesel HAD will need to be reevaluated.

For the EPA Diesel HAD, EPA reviewed 22 epidemiologic studies in detail, finding increased lung cancer risk in 8 out of 10 cohort studies and 10 out of 12 case-control studies. Relative risk for lung cancer associated with exposure range from 1.2 to 2.6. In addition, two meta-analyses of occupational studies of diesel exhaust and lung cancer have estimated the smoking-adjusted relative risk of 1.35 and 1.47, examining 23 and 30 studies, respectively.[33,34] That is, these two studies show an overall increase in lung cancer for the exposed groups of 35 percent and 47 percent compared to the groups not exposed to diesel exhaust. In the EPA Diesel HAD, EPA selected 1.4 as a reasonable estimate of occupational relative risk for further analysis.

EPA generally derives cancer unit risk estimates to calculate population risk more precisely from exposure to carcinogens. In the simplest terms, the cancer unit risk is the increased risk associated with average lifetime exposure of 1 ug/m^3. EPA concluded in the Diesel HAD that it is not possible currently to calculate a cancer unit risk for diesel exhaust due to a variety of factors that limit the current studies, such as a lack of standard exposure metric for diesel exhaust and the absence of quantitative exposure characterization in retrospective studies.

EPA generally derives cancer unit risk estimates to calculate population risk more precisely from exposure to carcinogens. In the simplest terms, the cancer unit risk is the increased risk associated with average lifetime exposure of 1 ug/m^3. EPA concluded in the Diesel HAD that it is not possible currently to calculate a cancer unit risk for diesel exhaust due to a variety of factors that limit the current studies, such as lack of an adequate dose-response relationship between exposure and cancer incidence.

However, in the absence of a cancer unit risk, the EPA Diesel HAD sought to provide additional insight into the possible ranges of risk that might be present in the population. Such insights, while not confident or definitive, nevertheless contribute to an understanding of the possible public health significance of the lung cancer hazard. The possible risk range analysis was developed by comparing a typical environmental exposure level to a selected range of occupational exposure levels and then proportionally scaling the occupationally observed risks according to the exposure ratio's to obtain an estimate of the possible environmental risk. If the occupational and environmental exposures are similar, the environmental risk would approach the risk seen in the occupational studies whereas a much higher occupational exposure indicates that the environmental risk is lower than the occupational risk. A comparison of environmental and occupational exposures showed that for certain occupations the exposures are similar to environmental exposures while, for others, they differ by a factor of about 200 or more.

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[33] Bhatia, R., Lopipero, P., Smith, A. (1998). Diesel exhaust exposure and lung cancer. Epidemiology 9(1):84-91.

[34] Lipsett, M: Campleman, S.; (1999). Occupational exposure to diesel exhaust and lung cancer: a meta-analysis. Am J Public Health 80(7):1009-1017.

The first step in this process is to note that the occupational relative risk of 1.4, or a 40 percent from increased risk compared to the typical 5 percent lung cancer risk in the U.S. population, translates to an increased risk of 2 percent (or 10^{-2}) for these diesel exhaust exposed workers. The Diesel HAD derived a typical nationwide average environmental exposure level of 0.8 ug./m^3 for diesel PM from highway sources for 1996. Diesel PM is a surrogate for diesel exhaust and, as mentioned above, has been classified as a carcinogen by some agencies.

This estimate was based on national exposure modeling; the derivation of this exposure is discussed in detail in the EPA Diesel HAD. The possible risk range in the environment was estimated by taking the relative risks in the occupational setting, EPA selected 1.4 and converting this to absolute risk of 2% and then ratioing this risk by differences in the occupational vs environmental exposures of interest. A number of calculations are needed to accomplish this, and these can be seen in the EPA Diesel HAD. The outcome was that environmental risks from diesel exhaust exposure could range from a low of 10^{-4} to 10^{-5} or be as high as 10^{-3} this being a reflection of the range of occupational exposures that could be associated with the relative and absolute risk levels observed in the occupational studies.

While these risk estimates are exploratory and not intended to provide a definitive characterization of cancer risk, they are useful in gauging the possible range of risk based on reasonable judgement. It is important to note that the possible risks could also be higher or lower and a zero risk cannot be ruled out. Some individuals in the population may have a high tolerance to exposure from diesel exhaust and low cancer susceptibility. Also, one cannot rule out the possibility of a threshold of exposure below which there is no cancer risk, although evidence has not been seen or substantiated on this point.

Also, as discussed in the Diesel HAD, there is a relatively small difference between some occupational settings where increased lung cancer risk is reported and ambient environmental exposures. The potential for small exposure differences underscores the appropriateness of the extrapolation from occupational risk to ambient environmental exposure levels is reasonable and appropriate.

EPA also recently completed an assessment of air toxic emissions (the National-Scale Air Toxics Assessment or NATA) and their associated risk, and we concluded that diesel exhaust ranks with other substances that the national-scale assessment suggests pose the greatest relative risk.[35] This assessment estimates average population inhalation exposures to diesel PM in 1996 for nonroad as well as on-road sources. These are the sum of ambient levels in various locations weighted by the amount of time people spend in each of the locations. This analysis shows a somewhat higher diesel exposure level than the 0.8 ug/m^3 used to develop the risk perspective in the Diesel HAD. The NATA levels are 1.4 ug/m^3 total with an on-road source contribution of 0.5 ug/m^3 to average nationwide exposure in 1996 and a nonroad source contribution of 0.9 ug/m^3. The average urban exposure concentration was 1.6 ug/m^3 and the average rural concentration was 0.55 ug/m^3. In five percent of urban census tracts across the United States,

[35] U.S. EPA (2002). National-Scale Air Toxics Assessment. This material is available electronically at http://www.epa.gov/ttn/atw/nata/

average concentrations were above 4.3 ug/m^3. The Diesel HAD states that use of the NATA exposure number results instead of the 0.8 ug/m^3 results in a similar risk perspective.

In 2001, EPA completed a rulemaking on mobile source air toxics with a determination that diesel particulate matter and diesel exhaust organic gases be identified as a Mobile Source Air Toxic (MSAT).[36] This determination was based on a draft of the Diesel HAD on which the Clean Air Scientific Advisory Committee of the Science Advisory Board had reached closure. The purpose of the MSAT list is to provide a screening tool that identifies compounds emitted from motor vehicles or their fuels for which further evaluation of emissions controls is appropriate.

In summary, even though EPA does not have a specific carcinogenic potency with which to accurately estimate the carcinogenic impact of diesel PM, the likely hazard to humans at environmental exposure levels leads us to conclude that diesel exhaust emissions of PM and organic gases should be reduced from nonroad engines in order to protect public health.

ii. Other Health Effects of Diesel Exhaust

The acute and chronic exposure-related effects of diesel exhaust emissions are also of concern to the Agency. The Diesel HAD established an inhalation Reference Concentration (RfC) specifically based on animal studies of diesel exhaust. An RfC is defined by EPA as "an estimate of a continuous inhalation exposure to the human population, including sensitive subgroups, with uncertainty spanning perhaps an order of magnitude, that is likely to be without appreciable risks of deleterious noncancer effects during a lifetime." EPA derived the RfC from consideration of four chronic rat inhalation studies showing adverse pulmonary effects. The diesel RfC is based on a "no observable adverse effect" level of 144 ug/m^3 that is further reduced by applying uncertainty factors of 3 for interspecies extrapolation and 10 for human variations in sensitivity. The resulting RfC derived in the Diesel HAD is 5 ug/m^3 for diesel exhaust as measured by diesel PM. This RfC does not consider allergenic effects such as those associated with asthma or immunologic effects. There is growing evidence that diesel exhaust can exacerbate these effects, but the exposure-response data is presently lacking to derive an RfC. Again, this RfC is based on animal studies and is meant to estimate exposure that is unlikely to have deleterious effects on humans based on those studies alone.

The Diesel HAD also briefly summarizes health effects associated with ambient PM and the EPA's annual NAAQS for $PM_{2.5}$ of 15 ug/m^3. There is a much more extensive body of human data showing a wide spectrum of adverse health effects associated with exposure to ambient PM, of which diesel exhaust is an important component due to its large contribution to ambient concentrations. The RfC is not meant to say that 5 ug/m^3 provides adequate public health protection for ambient $PM_{2.5}$. There may be benefits to reducing diesel PM below 5 ug/m^3 since

[36] U.S. EPA (2001). Control of Emissions of Hazardous Air Pollutants from Mobile Sources; Final Rule. 66 FR 17230 – 17273 (March 29, 2001).

diesel PM is a major contributor to ambient $PM_{2.5}$. Recent epidemiologic studies of ambient $PM_{2.5}$ do not indicate a threshold of effects at low concentrations. [37]

Also, as mentioned earlier in the health effects discussion for $PM_{2.5}$, there are a number of other health effects associated with PM in general, and motor vehicle exhaust including diesels in particular, that provide additional evidence for the need for significant emission reductions from nonroad diesel sources. For example, the Diesel HAD notes that acute or short-term exposure to diesel exhaust can cause acute irritation (e.g., eye, throat, bronchial), neurophysiological symptoms (e.g., lightheadedness, nausea), and respiratory symptoms (e.g., cough, phlegm). There is also evidence for an immunologic effect such as the exacerbation of allergenic responses to know allergens and asthma-like symptoms. All of these health effects plus the designation of diesel exhaust as a likely human carcinogen provide ample health justification for control.

iii. Ambient Levels and Exposure to Diesel Exhaust PM

Because diesel PM is part of overall ambient PM and cannot be easily distinguished from overall PM, we do not have direct measurements of diesel PM in the ambient air. Ambient diesel PM concentrations are estimated instead using one of three approaches: 1) ambient air quality modeling based on diesel PM emission inventories; 2) using elemental carbon concentrations in monitored data as surrogates; or 3) using the chemical mass balance (CMB) model in conjunction with ambient PM measurements. (Also, in addition to CMB, UNMIX/PMF have also been used). Estimates using these three approaches are described below. In addition, estimates developed using the first two approaches above are subjected to a statistical comparison to evaluate overall reasonableness of estimated concentrations. It is important to note that, while there are inconsistencies in some of these studies on the relative importance of gasoline and diesel PM, the studies which are discussed in the Diesel HAD all show that diesel PM is a significant contributor to overall ambient PM. Some of the studies differentiate nonroad from on-road diesel PM.

(1) Air Quality Modeling

In addition to the general ambient PM modeling conducted for this proposal, diesel PM concentrations specifically were recently estimated for 1996 as part of NATA. In this assessment, the PM inventory developed for the recent regulation promulgating 2007 heavy duty vehicle standards was used. Note that the nonroad inventory used in this modeling was based on an older version of the draft NONROAD Model which showed higher diesel PM than the current version. Ambient impacts of mobile source emissions were predicted using the Assessment System for Population Exposure Nationwide (ASPEN) dispersion model. Overall mean annual national levels for both on-road and nonroad diesels of 2.06 ug/m^3 diesel PM were calculated with a mean of 2.41 in urban counties and 0.74 in rural counties. These are ambient levels such

[37] EPA-SAB-Council-ADV-99-012, 1999. The Clean Air Act Amendments Section 812 Prospective Study of Costs and Benefits (1999): Advisory by the Health and Ecological Effects Subcommittee on Initial Assessments of Health and Ecological Effects, Part 1. July 28, 1999.

as would be seen at monitors rather than the exposure levels discussed earlier. Over half of the diesel PM comes from nonroad diesels.

Diesel PM concentrations were also recently modeled across a representative urban area, Houston, for 1996, using the Industrial Source Complex Short Term (ISCST3) model. This modeling is designed to more specifically account for local traffic patterns including diesel truck traffic along specific roadways. The modeling in Houston suggests strong spatial gradients for Diesel PM and indicates that "hotspot" concentrations can be very high, up to 8 ug/m^3 at receptor versus a 3 ug/m^3 average in Houston. Such concentrations are above the RfC for diesel exhaust and indicate a potential for adverse health effects from chronic exposure to diesel PM. These results also suggest that PM from diesel vehicles makes a major contribution to total ambient PM concentrations. Such "hot spot" concentrations along certain roadways suggest the presence of both high localized exposures plus higher estimated average annual exposure levels for urban centers than what has been estimated in assessments such as NATA, which are designed to focus on regional and national scale averages. There are similar "hot spot" concentrations in the immediate vicinity of use of nonroad equipment such as in urban construction sites.

(2) Elemental Carbon Measurements

As mentioned before, the carbonaceous component is significant in ambient PM. The carbonaceous component consists of organic carbon and elemental carbon. Monitoring data on elemental carbon concentrations can be used as a surrogate to determine ambient diesel PM concentrations. Elemental carbon is a major component of diesel exhaust, contributing to approximately 60 to 80 percent of diesel particulate mass, depending on engine technology, fuel type, duty cycle, lube oil consumption, and state of engine maintenance. In most areas, diesel engine emissions are major contributors to elemental carbon in the ambient air, with other potential sources including gasoline exhaust, combustion of coal, oil, or wood (including forest fires), charbroiling, cigarette smoke, and road dust. Because of the large portion of elemental carbon in diesel particulate matter, and the fact that diesel exhaust is one of the major contributors to elemental carbon in most areas, ambient diesel PM concentrations can be bounded using elemental carbon measurements.

The measured mass of elemental carbon at a given site varies depending on the measurement technique used. Moreover, to estimate diesel PM concentration based on elemental carbon level, one must first estimate the percentage of PM attributable to diesel engines and the percentage of elemental carbon in diesel PM. Thus, there are significant uncertainties in estimating diesel PM concentrations using an elemental carbon surrogate. Depending on the measurement technique used, and assumptions made, average nationwide concentrations for current years of diesel PM estimated from elemental carbon data range from about 1.2 to 2.2 ug/m^3. EPA has compared these estimates based on elemental carbon measurements to modeled concentrations in NATA and concluded that the two sets of data agree reasonably well. This performance compares favorably with the model to monitor results for other pollutants assessed in NATA, with the exception of benzene, for which the performance of the NATA modeling was better. These comparisons are discussed in greater detail in the draft RIA.

(3) Chemical Mass Balance

The third approach for estimating ambient diesel PM concentrations uses the CMB model for source apportionment in conjunction with ambient PM measurements and chemical source "fingerprints" to estimate ambient diesel PM concentrations. The CMB model uses a statistical fitting technique to determine how much mass from each source would be required to reproduce the chemical fingerprint of each speciated ambient monitor. This source apportionment technique presently does not distinguish between on-road and nonroad but, instead, gives diesel PM as a whole. This source apportionment technique can distinguish between diesel and gasoline PM. Caution in interpreting CMB results is warranted, as the use of fitting species that are not specific to the sources modeled can lead to misestimation of source contributions. Ambient concentrations using this approach are generally about 1 ug/m^3 annual average. UNMIX/PMF models show similar results. Results from various studies are discussed in the draft RIA.

iv. Diesel Exhaust PM Exposures

Exposure of people to diesel exhaust depends on their various activities, the time spent in those activities, the locations where these activities occur, and the levels of diesel exhaust pollutants (such as particulate) in those locations. The major difference between ambient levels of diesel particulate and exposure levels for diesel particulate is that exposure accounts for a person moving from location to location, proximity to the emission source, and whether the exposure occurs in an enclosed environment.

(1) Occupational Exposures

Diesel particulate exposures have been measured for a number of occupational groups over various years but generally for more recent years (1980s and later) rather than earlier years. Occupational exposures had a wide range varying from 2 to 1,280 ug/m^3 for a variety of occupational groups including miners, railroad workers, firefighters, air port crew, public transit workers, truck mechanics, utility linemen, utility winch truck operators, fork lift operators, construction workers, truck dock workers, short-haul truck drivers, and long-haul truck drivers. These individual studies are discussed in the Diesel HAD. As discussed in the Diesel HAD, the National Institute of Occupational Safety and Health (NIOSH) has estimated a total of 1,400,000 workers are occupationally exposed to diesel exhaust from on-road and nonroad equipment.

Many measured or estimated occupational exposures are for on-road diesel engines although some (especially the higher ones) are for occupational groups (e.g., fork lift operators, construction workers, or mine workers) who would be exposed to nonroad diesel exhaust. Sometimes, as is the case for the nonroad engines, there are only estimates of exposure based on the length of employment or similar factors rather than a ug/m^3 level. Estimates for exposures to diesel PM for diesel fork lift operators have been made that range from 7 to 403 ug/m^3 as reported in the Diesel HAD. In addition, the Northeast States for Coordinated Air Use Management (NESCAUM) is presently measuring occupational exposures to particulate and elemental carbon near the operation of various diesel non-road equipment. Exposure groups include agricultural farm operators, grounds maintenance personnel (lawn and garden equipment), heavy equipment operators conducting multiple job tasks at a construction site, and a saw mill crew at a lumber yard. Samples will be obtained in the breathing zone of workers. Some initial results are expected in late 2003.

(2) General Ambient Exposures

Currently, personal exposure monitors for PM cannot differentiate diesel from other PM. Thus, we use modeling to estimate exposures. Specifically, exposures for the general population are estimated by first conducting dispersion modeling of both on-road and non-road diesel emissions, described above, and then by conducting exposure modeling. The most comprehensive modeling for cumulative exposures to diesel PM is the NATA. This assessment calculates exposures of the national population as a whole to a variety of air toxics, including diesel PM. As discussed previously, the ambient levels are calculated using the ASPEN dispersion model. The preponderance of modeled diesel PM concentrations are within a factor of 2 of diesel PM concentrations estimated from elemental carbon measurements.[38] This comparison adds credence to the modeled ASPEN results and associated exposure assessment.

The modeled ambient concentrations are used as inputs into the Hazardous Air Pollution Exposure Model (HAPEM4) to calculate exposure levels. Average exposures calculated nationwide are 1.44 ug/m^3 with levels of 1.64 ug/m^3 for urban counties and 0.55 ug/m^3 for rural counties. Again, nonroad diesels account for over half of this modeled exposure.

(3) Ambient Exposures - Microenvironments

One common microenvironment for diesel exposure is beside freeways. Although freeway locations are associated mostly with on-road rather than nonroad diesels, there are many similarities between on-road and nonroad diesel emissions as discussed in the Diesel HAD. The California Air Resources Board (CARB) measured elemental carbon near the Long Beach Freeway in 1993. Levels measured ranged from 0.4 to 4.0 ug/m^3 (with one value as high as 7.5 ug/m^3) above background levels. Microenvironments associated with nonroad engines would include construction zones. PM and elemental carbon samples are being collected by NESCAUM in the immediate area of the nonroad engine operations (such as at the edge or fence line of the construction zone). Besides PM and elemental carbon levels, various toxics such as benzene, 1,3-butadiene, formaldehyde, and acetaldehyde will be sampled. Some initial results should be available in late 2003 and will be especially useful since they focus on those microenvironments affected by nonroad diesels.

Also, EPA is funding research in Fresno to measure indoor and outdoor PM component concentrations in the homes of over 100 asthmatic children. Some of these homes are located near agricultural, construction, and utility nonroad equipment operations. This work will measure infiltration of elemental carbon and other PM components to indoor environments. The

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[38] U.S. EPA (2002). Diesel PM model-to-measurement comparison. Prepared by ICF Consulting for EPA, Office of Transportation and Air Quality. Report No. EPA420-D-02-004.

project also evaluates lung function changes in the asthmatic children during fluctuations in exposure concentrations and compositions. This information may allow an evaluation of adverse health effects associated with exposures to elemental carbon and other PM components from on-road and nonroad sources. Some initial results may be available in late 2003.

b. Gaseous Air Toxics

Nonroad diesel engine emissions contain several substances known or suspected as human or animal carcinogens, or that have noncancer health effects. These other compounds include benzene,1,3-butadiene, formaldehyde, acetaldehyde, acrolein, dioxin, and polycyclic organic matter (POM). For some of these pollutants, nonroad diesel engine emissions are believed to account for a significant proportion of total nation-wide emissions. All of these compounds were identified as national or regional "risk" drivers in the 1996 NATA. That is, these compounds pose a significant portion of the total inhalation cancer risk to a significant portion of the population. Mobile sources contribute significantly to total emissions of these air toxics. As discussed later in this section, this proposed rulemaking will result in significant reductions of these emissions.

<u>Benzene</u>**:** Nonroad diesel engines accounted for about 3 percent of ambient benzene emissions in 1996. Of ambient benzene levels due to mobile sources, 5 percent in urban and 3 percent in rural areas came from nonroad diesel.

The EPA's IRIS database lists benzene as a known human carcinogen (causing leukemia at high, prolonged air exposures) by all routes of exposure, and exposure is associated with additional health effects including genetic changes in humans and animals and increased proliferation of bone marrow cells in mice.[39, 40, 41, 42] EPA states in its IRIS database that the data indicate a causal relationship between benzene exposure and acute lymphocytic leukemia and suggest a relationship between benzene exposure and chronic non-lymphocytic leukemia and chronic lymphocytic leukemia. Respiration is the major source of human exposure and at least half of this exposure is attributable to gasoline vapors and automotive emissions. A number of

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[39] U.S. EPA (2000). Integrated Risk Information System File for Benzene. This material is available electronically at http://www.epa.gov/iris/subst/0276.htm

[40] International Agency for Research on Cancer, IARC monographs on the evaluation of carcinogenic risk of chemicals to humans, Volume 29, Some industrial chemicals and dyestuffs, International Agency for Research on Cancer, World Health Organization, Lyon, France, p. 345-389, 1982.

[41] Irons, R.D., W.S. Stillman, D.B. Colagiovanni, and V.A. Henry, Synergistic action of the benzene metabolite hydroquinone on myelopoietic stimulating activity of granulocyte/macrophage colony-stimulating factor *in vitro*, Proc. Natl. Acad. Sci. 89:3691-3695, 1992.

[42] U.S. EPA (1998). Carcinogenic Effects of Benzene: An Update, National Center for Environmental Assessment, Washington, DC. 1998.

adverse noncancer health effects including blood disorders, such as preleukemia and aplastic anemia, have also been associated with low-dose, long-term exposure to benzene.[43, 44]

1,3-Butadiene: Nonroad diesel engines accounted for about 1.5 percent of ambient butadiene emissions in 1996. Of ambient butadiene levels due to mobile sources, 4 percent in urban and 2 percent in rural areas came from nonroad diesel.

EPA earlier identified 1,3-butadiene as a probable human carcinogen in its IRIS database and recently redesignated it as a known human carcinogen (but with a lower carcinogenic potency than previously used).[45] The specific mechanisms of 1,3-butadiene-induced carcinogenesis are unknown, however, it is virtually certain that the carcinogenic effects are mediated by genotoxic metabolites of 1,3-butadiene. Animal data suggest that females may be more sensitive than males for cancer effects; nevertheless, there are insufficient data from which to draw any conclusions on potentially sensitive subpopulations. 1,3-Butadiene also causes a variety of reproductive and developmental effects in mice; no human data on these effects are available. The most sensitive effect was ovarian atrophy observed in a lifetime bioassay of female mice.[46]

Formaldehyde: Nonroad diesel engines accounted for about 22 percent of ambient formaldehyde emissions in 1996. Of ambient formaldehyde levels due to mobile sources, 37 percent in urban and 27 percent in rural areas came form nonroad diesel. These figures are for tailpipe emissions of formaldehyde. Formaldehyde in the ambient air comes not only from tailpipe (of direct) emissions but is also formed from photochemical reactions of hydrocarbons.

EPA has classified formaldehyde as a probable human carcinogen based on evidence in humans and in rats, mice, hamsters, and monkeys.[47] Epidemiological studies in occupationally exposed workers suggest that long-term inhalation of formaldehyde may be associated with tumors of the nasopharyngeal cavity (generally the area at the back of the mouth near the nose), nasal cavity, and sinus.[48] Formaldehyde exposure also causes a range of noncancer health

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[43] Aksoy, M. (1989). Hematotoxicity and carcinogenicity of benzene. Environ. Health Perspect. 82: 193-197.

[44] Goldstein, B.D. (1988). Benzene toxicity. Occupational medicine. State of the Art Reviews. 3: 541-554.

[45] U.S. EPA (2002). Health Assessment of 1,3-Butadiene. Office of Research and Development, National Center for Environmental Assessment, Washington Office, Washington, DC. Report No. EPA/600/P-98/001F.

[46] Bevan, C; Stadler, JC; Elliot, GS; et al. (1996) Subchronic toxicity of 4-vinylcyclohexene in rats and mice by inhalation. Fundam. Appl. Toxicol. 32:1-10.

[47] U.S. EPA (1987). Assessment of Health Risks to Garment Workers and Certain Home Residents from Exposure to Formaldehyde, Office of Pesticides and Toxic Substances, April 1987.

[48] Blair, A., P.A. Stewart, R.N. Hoover, et al. (1986). Mortality among industrial workers exposed to formaldehyde. J. Natl. Cancer Inst. 76(6): 1071-1084.

effects, including irritation of the eyes (tearing of the eyes and increased blinking) and mucous membranes. Sensitive individuals may experience these adverse effects at lower concentrations than the general population and in persons with bronchial asthma, the upper respiratory irritation caused by formaldehyde can precipitate an acute asthmatic attack. The agency is currently conducting a reassessment of risk from inhalation exposure to formaldehyde.

Acetaldehyde: Nonroad diesel engines accounted for about 34 percent of acetaldehyde emissions in 1996. Of ambient acetaldehyde levels due to mobile sources, 24 percent in urban and 17 percent in rural areas came form nonroad diesel. Also, acetaldehyde can be formed photochemically in the atmosphere. Counting both direct emissions and photochemically formed acetaldehyde, mobile sources were responsible for the major portion of acetaldehyde in the ambient air according to the National-Scale Air Toxics Assessment for 1996.

Acetaldehyde is classified in EPA's IRIS database as a probable human carcinogen and is considered moderately toxic by the inhalation, oral, and intravenous routes.[49] The primary acute effect of exposure to acetaldehyde vapors is irritation of the eyes, skin, and respiratory tract. At high concentrations, irritation and pulmonary effects can occur, which could facilitate the uptake of other contaminants. Some asthmatics have been shown to be a sensitive subpopulation to decrements in FEV1 upon acetaldehyde inhalation.[50] The agency is currently conducting a reassessment of risk from inhalation exposure to acetaldehyde.

Acrolein: Nonroad diesel engines accounted for about 17.5 percent of acrolein emissions in 1996. Of ambient acrolein levels due to mobile sources, 28 percent in urban and 18 percent in rural areas came form nonroad diesel.

Acrolein is extremely toxic to humans when inhaled, with acute exposure resulting in upper respiratory tract irritation and congestion. The Agency has developed a reference concentration for inhalation (RfC) of acrolein of 0.02 micrograms/m^3.[51] Although no information is available on its carcinogenic effects in humans, based on laboratory animal data, EPA considers acrolein a possible human carcinogen.

Polycyclic Organic Matter (POM): POM is generally defined as a large class of chemicals consisting of organic compounds having multiple benzene rings and a boiling point greater than 100 degrees C. Polycyclic aromatic hydrocarbons (PAHs) are a chemical class that is a subset of POM. POM are naturally occurring substances that are byproducts of the incomplete combustion of fossil fuels and plant and animal biomass (e.g., forest fires). They occur as byproducts from steel and coke productions and waste incineration. They also are a

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[49] U.S. EPA (1988). Integrated Risk Information System File of Acetaldehyde. This material is available electronically at http://www.epa.gov/iris/subst/0290.htm.

[50] Myou, S.; Fujimura, M.; Nishi K.; Ohka, T.; and Matsuda, T. (1993) Aerosolized acetaldehyde induces histamine-mediated bronchoconstriction in asthmatics. Am Rev Respir Dis 148(4 Pt 1): 940-3.

[51] U.S. EPA (1993). Environmental Protection Agency, Integrated Risk Information System (IRIS), National Center for Environmental Assessment, Cincinnati, OH.

component of diesel particulate emissions. Many of the compounds included in the class of compounds known as POM are classified by EPA as probable human carcinogens based on animal data. In particular, EPA frequently obtains data on 7 of the POM compounds, which we analyzed separately as a class in the 1996 NATA. Nonroad diesel engines account for less than 1 percent of these 7 POM compounds with total mobile sources responsible for only 4 percent of the total; most of the 7 POMs come from area sources. For total POM compounds, mobile sources as a whole are responsible for only 1 percent. The mobile source emission numbers used to derive these inventories are based on only particulate phase POM and do not include the semi-volatile phase POM levels. Were those additional POMs included (which is now being done), these inventory numbers would be substantially higher.

Even though mobile sources are responsible for only a small portion of total POM emissions, the particulate reductions from today's action will reduce these emissions.

Dioxins: Recent studies have confirmed that dioxins are formed by and emitted from diesels (both heavy-duty diesel trucks and non-road diesels although in very small amounts) and are estimated to account for about 1 percent of total dioxin emissions in 1995. Recently EPA issued a draft assessment designating one dioxin compound, 2,3,7,8-tetrachlorodibenzo-p-dioxin as a human carcinogen and the complex mixtures of dioxin-like compounds as likely to be carcinogenic to humans using the draft 1996 carcinogen risk assessment guidelines. EPA is working on its final assessment for dioxin.[52] An interagency review group is evaluating EPA's designation of dioxin as a likely human carcinogen. Reductions from today's nonroad proposal will have minimal impact on overall dioxin emissions.

3. Ozone

a. What are the health effects of ozone pollution?

Ground-level ozone pollution (sometimes called "smog") is formed by the reaction of volatile organic compounds (VOC) and nitrogen oxides (NOx) in the atmosphere in the presence of heat and sunlight. These two pollutants, often referred to as ozone precursors, are emitted by many types of pollution sources, including on-road and off-road motor vehicles and engines, power plants and industrial facilities, and smaller "area" sources.

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[52] US EPA (June 2000) Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds, External Review Draft, EPA/600/P-00/001Ag. This material is available electronically at http://www.epa.gov/ncea/dioxin.htm.

Ozone can irritate the respiratory system, causing coughing, throat irritation, and/or uncomfortable sensation in the chest.[53, 54] Ozone can reduce lung function and make it more difficult to breathe deeply, and breathing may become more rapid and shallow than normal, thereby limiting a person's normal activity. Ozone also can aggravate asthma, leading to more asthma attacks that require a doctor's attention and/or the use of additional medication. In addition, ozone can inflame and damage the lining of the lungs, which may lead to permanent changes in lung tissue, irreversible reductions in lung function, and a lower quality of life if the inflammation occurs repeatedly over a long time period (months, years, a lifetime). People who are of particular concern with respect to ozone exposures include children and adults who are active outdoors. Those people particularly susceptible to ozone effects are people with respiratory disease, such as asthma, and people with unusual sensitivity to ozone, and children. Beyond its human health effects, ozone has been shown to injure plants, which has the effect of reducing crop yields and reducing productivity in forest ecosystems.[55, 56]

The 8-hour ozone standard, established by EPA in 1997, is based on well-documented science demonstrating that more people are experiencing adverse health effects at lower levels of exertion, over longer periods, and at lower ozone concentrations than addressed by the one-hour ozone standard. (See, e.g., 62 FR 38861-62, July 18, 1997). The 8-hour standard addresses ozone exposures of concern for the general population and populations most at risk, including children active outdoors, outdoor workers, and individuals with pre-existing respiratory disease, such as asthma.

There has been new research that suggests additional serious health effects beyond those that had been known when the 8-hour ozone health standard was set. Since 1997, over 1,700 new health and welfare studies relating to ozone have been published in peer-reviewed journals.[57] Many of these studies have investigated the impact of ozone exposure on such health effects as changes in lung structure and biochemistry, inflammation of the lungs, exacerbation and causation of asthma, respiratory illness-related school absence, hospital and emergency room

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[53] U.S. EPA (1996). Air Quality Criteria for Ozone and Related Photochemical Oxidants, EPA/600/P-93/004aF. Docket No. A-99-06. Document Nos. II-A-15 to 17.

[54] U.S. EPA. (1996). Review of National Ambient Air Quality Standards for Ozone, Assessment of Scientific and Technical Information, OAQPS Staff Paper, EPA-452/R-96-007. Docket No. A-99-06. Document No. II-A-22.

[55] U.S. EPA (1996). Air Quality Criteria for Ozone and Related Photochemical Oxidants, EPA/600/P-93/004aF. Docket No. A-99-06. Document Nos. II-A-15 to 17.

[56] U.S. EPA. (1996). Review of National Ambient Air Quality Standards for Ozone, Assessment of Scientific and Technical Information, OAQPS Staff Paper, EPA-452/R-96-007. Docket No. A-99-06. Document No. II-A-22.

[57] New Ozone Health and Environmental Effects References, Published Since Completion of the Previous Ozone AQCD, National Center for Environmental Assessment, Office of Research and Development, US Environmental Protection Agency, Research Triangle Park, NC 27711 (7/2002) Docket No. A-2001-11. Document No. IV-A-19.

visits for asthma and other respiratory causes, and premature mortality. EPA is currently in the process of evaluating these and other studies as part of the ongoing review of the air quality criteria and NAAQS for ozone. A revised Air Quality Criteria Document for Ozone and Other Photochemical Oxidants will be prepared in consultation with EPA's Clean Air Science Advisory Committee (CASAC). Key new health information falls into four general areas: development of new-onset asthma, hospital admissions for young children, school absence rate, and premature mortality.

Aggravation of existing asthma resulting from short-term ambient ozone exposure was reported prior to the 1997 decision and has been observed in studies published subsequently.[58, 59] In particular, a relationship between long-term ambient ozone concentrations and the incidence of new-onset asthma in adult males (but not in females) was reported by McDonnell et al. (1999).[60] Subsequently, an additional study suggests that incidence of new diagnoses of asthma in children is associated with heavy exercise in communities with high concentrations (i.e., mean 8-hour concentration of 59.6 ppb) of ozone.[61] This relationship was documented in children who played 3 or more sports and thus had higher exposures and was not documented in those children who played one or two sports. The larger effect of high activity sports than low activity sports and an independent effect of time spent outdoors also in the higher ozone communities strengthened the inference that exposure to ozone may modify the effect of sports on the development of asthma in some children.

Previous studies have shown relationships between ozone and hospital admissions in the general population. A study in Toronto reported a significant relationship between 1-hour maximum ozone concentrations and respiratory hospital admissions in children under the age of two.[62] Given the relative vulnerability of children in this age category, we are particularly concerned about the findings.

Increased respiratory disease that are serious enough to cause school absences have been associated with 1-hour daily maximum and 8-hour average ozone concentrations in studies

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[58] Thurston, G.D., M.L. Lippman, M.B. Scott, and J.M. Fine. 1997. Summertime Haze Air Pollution and Children with Asthma. *American Journal of Respiratory Critical Care Medicine*, 155: 654-660.

[59] Ostro, B, M. Lipsett, J. Mann, H. Braxton-Owens, and M. White (2001) Air pollution and exacerbation of asthma in African-American children in Los Angeles. *Epidemiology* 12(2): 200-208.

[60] McDonnell, W.F., D.E. Abbey, N. Nishino and M.D. Lebowitz. 1999. "Long-term ambient ozone concentration and the incidence of asthma in nonsmoking adults: the ahsmog study." *Environmental Research*. 80(2 Pt 1): 110-121.

[61] McConnell, R.; Berhane, K.; Gilliland, F.; London, S. J.; Islam, T.; Gauderman, W. J.; Avol, E.; Margolis, H. G.; Peters, J. M. (2002) Asthma in exercising children exposed to ozone: a cohort study. Lancet 359: 386-391.

[62] Burnett, R. T.; Smith_Doiron, M.; Stieb, D.; Raizenne, M. E.; Brook, J. R.; Dales, R. E.; Leech, J. A.; Cakmak, S.; Krewski, D. (2001) Association between ozone and hospitalization for acute respiratory diseases in children less than 2 years of age. Am. J. Epidemiol. 153: 444-452.

conducted in Nevada[63] in kindergarten to 6th grade and in Southern California in grades 4-through 6.[64] These studies suggest that higher ambient ozone levels may result in increased school absenteeism.

The air pollutant most clearly associated with premature mortality is PM, with dozens of studies reporting such an association. However, repeated ozone exposure is a possible contributing factor for premature mortality, causing an inflammatory response in the lungs which may predispose elderly and other sensitive individuals to become more susceptible to other stressors, such as PM.[65, 66, 67] Although the findings have been mixed, the findings of three recent analyses suggest that ozone exposure is associated with increased mortality. Although the National Morbidity, Mortality, and Air Pollution Study (NMMAPS) did not report an effect of ozone on total mortality across the full year, the investigators who conducted the NMMAPS study did observe an effect after limiting the analysis to summer when ozone levels are highest.[68, 69] Similarly, other studies have shown associations between ozone and mortality.[70, 71]

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[63] Chen, L.; Jennison, B. L.; Yang, W.; Omaye, S. T. (2000) Elementary school absenteeism and air pollution. Inhalation Toxicol. 12: 997-1016.

[64] Gilliland, FD, K Berhane, EB Rappaport, DC Thomas, E Avol, WJ Gauderman, SJ London, HG Margolis, R McConnell, KT Islam, JM Peters (2001) The effects of ambient air pollution on school absenteeism due to respiratory illnesses *Epidemiology* 12:43-54.

[65] Samet JM, Zeger SL, Dominici F, Curriero F, Coursac I, Dockery DW, Schwartz J, Zanobetti A. 2000. The National Morbidity, Mortality and Air Pollution Study: Part II: Morbidity, Mortality and Air Pollution in the United States. Research Report No. 94, Part II. Health Effects Institute, Cambridge MA, June 2000. (Docket Number A-2000-01, Document Nos. IV-A-208 and 209)

[66] Devlin, R. B.; Folinsbee, L. J.; Biscardi, F.; Hatch, G.; Becker, S.; Madden, M. C.; Robbins, M.; Koren, H. S. (1997) Inflammation and cell damage induced by repeated exposure of humans to ozone. Inhalation Toxicol. 9: 211-235.

[67] Koren HS, Devlin RB, Graham DE, Mann R, McGee MP, Horstman DH, Kozumbo WJ, Becker S, House DE, McDonnell SF, Bromberg, PA. 1989. Ozone-induced inflammation in the lower airways of human subjects. Am. Rev. Respir. Dies. 139: 407-415.

[68] Samet JM, Zeger SL, Dominici F, Curriero F, Coursac I, Dockery DW, Schwartz J, Zanobetti A. 2000. The National Morbidity, Mortality and Air Pollution Study: Part II: Morbidity, Mortality and Air Pollution in the United States. Research Report No. 94, Part II. Health Effects Institute, Cambridge MA, June 2000. (Docket Number A-2000-01, Documents No. IV-A-208 and 209)

[69] Samet JM, Zeger SL, Dominici F, Curriero F, Coursac I, Zeger, S. Fine Particulate Air Pollution and Mortality in 20 U.S. Cities, 1987 - 1994. The New England Journal of Medicine. Vol. 343, No. 24, December 14, 2000. P. 1742-1749.

[70] Thurston, G. D.; Ito, K. (2001) Epidemiological studies of acute ozone exposures and mortality. J. Exposure Anal. Environ. Epidemiol. 11: 286-294.

[71] Touloumi, G.; Katsouyanni, K.; Zmirou, D.; Schwartz, J.; Spix, C.; Ponce de Leon, A.; Tobias, A.; Quennel, P.; Rabczenko, D.; Bacharova, L.; Bisanti, L.; Vonk, J. M.; Ponka, A. (1997) Short-term effects of ambient oxidant exposure on mortality: a combined analysis within the APHEA project. Am. J. Epidemiol. 146: 177-185.

Specifically, Toulomi et al. (1997) found that 1-hour maximum ozone levels were associated with daily numbers of deaths in 4 cities (London, Athens, Barcelona, and Paris), and a quantitatively similar effect was found in a group of four additional cities (Amsterdam, Basel, Geneva, and Zurich).

In all, the new studies that have become available since the 8-hour ozone standard was adopted in 1997 continue to demonstrate the harmful effects of ozone on public health, and the need to attain and maintain the NAAQS.

b. Current and projected 8-hour ozone levels

As shown earlier (Figure II-1), unhealthy ozone concentrations exceeding the level of the 8-hour standard (i.e., not requisite to protect the public health with an adequate margin of safety) occur over wide geographic areas, including most of the nation's major population centers. These monitored areas include much of the eastern half of the U.S. and large areas of California.

Based upon data from 1999 - 2001, there are 291 counties where 111 million people live that are measuring values that violate the 8-hour ozone NAAQS.[72] An additional 37 million people live in 155 counties that have air quality measurements within 10 percent of the level of the standard. These areas, though currently not violating the standard, will also benefit from the additional emission reductions from this rule.

From our air quality modeling for this proposal, we anticipate that without emission reductions beyond those already required under promulgated regulation and approved SIPs, ozone nonattainment will likely persist into the future. With reductions from programs already in place, the number of counties violating the ozone 8-hour standard is expected to decrease in 2020 to 30 counties where 43 million people are projected to live. Thereafter, exposure to unhealthy levels of ozone is expected to begin to increase again. In 2030 the number of counties violating the ozone 8-hour NAAQS is projected to increase to 32 counties where 47 million people are projected to live. In addition, in 2030, 82 counties where 44 million people are projected to live will be within 10 percent of violating the ozone 8-hour NAAQS.

EPA is still developing the implementation process for bringing the nation's air into attainment with the ozone 8-hour NAAQS. EPA's current plans call for designating ozone 8-hour nonattainment areas in April 2004. EPA is planning to propose that States submit SIPs that address how areas will attain the 8-hour ozone standard within three years after nonattainment designation regardless of their classification. EPA is also planning to propose that certain SIP components, such as those related to reasonably available control technology (RACT) and reasonable further progress (RFP) be submitted within 2 years after designation. We therefore anticipate that States will submit their attainment demonstration SIPs by April 2007. Section 172(a)(2) of the Clean Air Act requires that SIP revisions for areas that may be covered only under subpart 1 of part D, Title I of the Act demonstrate that the nonattainment areas will attain

[72] Additional counties may have levels above the NAAQS but do not currently have monitors.

the ozone 8-hour standard as expeditiously as practicable but no later than five years from the date that the area was designated nonattainment. However, based on the severity of the air quality problem and the availability and feasibility of control measures, the Administrator may extend the attainment date "for a period of no greater than 10 years from the date of designation as nonattainment." Based on these provisions, we expect that most or all areas covered under subpart 1 will attain the ozone standard in the 2007 to 2014 time frame. For areas covered under subpart 2, the maximum attainment dates provided under the Act range from 3 to 20 years after designation, depending on an area's classification. Thus, we anticipate that areas covered by subpart 2 will attain in the 2007 to 2014 time period.

Since the emission reductions expected from this proposal would begin during the same time period, the projected reductions in nonroad emissions would be extremely important to States in their effort to meet the new NAAQS. It is our expectation that States will be relying on such nonroad reductions in order to help them attain and maintain the 8-hour NAAQS. Furthermore, since the nonroad emission reductions will continue to grow in the years beyond 2014, they will also be important for maintenance of the NAAQS for areas with attainment dates of 2014 and earlier.

Using air quality modeling of the impacts of emission reductions, we have made estimates of the change in future ozone levels that would result from the proposed rule.[73] That modeling shows that this rule would produce nationwide air quality improvements in ozone levels. On a population-weighted basis, the average change in future year design values would be a decrease of 1.6 ppb in 2020, and 2.6 ppb in 2030. Within areas predicted to violate the NAAQS in the projected base case, the average decrease would be somewhat higher: 1.9 ppb in 2020 and 3.0 ppb in 2030.[74]

The model predictions of whether specific counties will violate the NAAQS or not is uncertain, especially for counties with design values falling very close to the standard. This makes us more confident in our prediction of average air quality changes than in our prediction of the exact numbers of counties projected as exceeding the NAAQS. Furthermore, actions by States to meet their SIP obligations will change the number of counties violating the NAAQS in the time frame we are modeling for this rule. If State actions resulted in an increase in the number of areas that are very close to, but still above, the NAAQS, then this rule might bring many of those counties down sufficiently to eliminate remaining violations. In addition, if State actions brought several counties we project to be very close to the standard in the future down sufficiently to eliminate violations, then the air quality improvements from this proposal might serve more to assist these areas in maintaining the standards than in changing their status.

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[73] These results are ozone changes projected for the preliminary control option used for our modeling, as discussed in the Draft RIA in Section 3.6. The proposal differs from the modeled control case based on updated information; however, we believe that the net results would approximate future emissions, although we anticipate the ozone changes might be slightly different.

[74] This is in spite of the fact that NOx reductions can at certain times in some areas cause ozone levels to increase. Such "disbenefits" are predicted in our modeling, but these results make clear that the overall effect of the proposed rule is positive. See the draft RIA for more information.

Bearing this in mind, our modeling indicates that, out of 32 counties predicted to violate the NAAQS, the proposal would reduce the number of violating counties by 2 in 2020 and by 4 in 2030, without consideration of new State or Federal programs.

C. Other Environmental Effects

The following section presents information on five categories of public welfare and environmental impacts related to nonroad heavy-duty vehicle emissions: visibility impairment, acid deposition, eutrophication of water bodies, plant damage from ozone, and water pollution resulting from deposition of toxic air pollutants with resulting effects on fish and wildlife.

1. Visibility

a. Visibility is Impaired by Fine PM and Precursor Emissions From Nonroad Engines Subject to this Proposed Rule

Visibility can be defined as the degree to which the atmosphere is transparent to visible light.[75] Fine particles with significant light-extinction efficiencies include organic matter, sulfates, nitrates, elemental carbon (soot), and soil. Size and chemical composition of particles strongly affects their ability to scatter or absorb light. Sulfates contribute to visibility impairment especially on the haziest days across the U.S., accounting in the rural Eastern U.S. for more than 60 percent of annual average light extinction on the best days and up to 86 percent of average light extinction on the haziest days. Nitrates and elemental carbon each typically contribute 1 to 6 percent of average light extinction on haziest days in rural Eastern U.S. locations.[76]

Visibility is important because it directly affects people's enjoyment of daily activities in all parts of the country. Individuals value good visibility for the well-being it provides them directly, both in where they live and work, and in places where they enjoy recreational opportunities. Visibility is also highly valued in significant natural areas such as national parks and wilderness areas, because of the special emphasis given to protecting these lands now and for future generations.

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[75] National Research Council, 1993. Protecting Visibility in National Parks and Wilderness Areas. National Academy of Sciences Committee on Haze in National Parks and Wilderness Areas. National Academy Press, Washington, DC. This document is available on the internet at http://www.nap.edu/books/0309048443/html/. See also U.S. EPA Air Quality Criteria Document for Particulate Matter (1996) (available on the internet at http://cfpub.epa.gov/ncea/cfm/partmatt.cfm) and Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information. These documents can be found in Docket A-99-06, Documents No. II-A-23 and IV-A-130-32.

[76] US EPA Trends Report 2001. This document is available on the internet at http://www.epa.gov/airtrends/.

To quantify changes in visibility, we compute a light-extinction coefficient, which shows the total fraction of light that is decreased per unit distance. Visibility can be described in terms of visual range or light extinction and is reported using an indicator called deciview.[77] In addition to limiting the distance that one can see, the scattering and absorption of light caused by air pollution can also degrade the color, clarity, and contrast of scenes.

In addition, visibility impairment can be described by its impact over various periods of time, by its source, and the physical conditions in various regions of the country. Visibility impairment can be said to have a time dimension in that it might relate to short-term excursions or to longer periods (e.g., worst 20 percent of days and annual average levels). Anthropogenic contributions account for about one-third of the average extinction coefficient in the rural West and more than 80 percent in the rural East. In the Eastern U.S., reduced visibility is mainly attributable to secondarily formed particles, particularly those less than a few micrometers in diameter, such as sulfates. While secondarily formed particles still account for a significant amount in the West, primary emissions contribute a larger percentage of the total particulate load than in the East. Because of significant differences related to visibility conditions in the Eastern and Western U.S., we present information about visibility by region.

Furthermore, it is important to note that even in those areas with relatively low concentrations of anthropogenic fine particles, such as the Colorado Plateau, small increases in anthropogenic fine particulate concentrations can lead to significant decreases in visual range. This is one of the reasons mandatory Federal Class I areas have been given special consideration under the Clean Air Act.[78]

b. Visibility Impairment Where People Live, Work and Recreate

The secondary PM NAAQS is designed to protect against adverse welfare effects which includes visibility impairment. In 1997, EPA established the secondary $PM_{2.5}$ NAAQS as equal to the primary (health-based) NAAQS of 15 ug/m^3 (based on a 3-year average of the annual mean) and 65 ug/m^3 (based on a 3-year average of the 98th percentile of the 24-hour average value) (62 FR 38669, July 18, 1997). EPA concluded that $PM_{2.5}$ causes adverse effects on visibility in various locations, depending on PM concentrations and factors such as chemical composition and average relative humidity. In 1997, EPA demonstrated that visibility impairment is an important effect on public welfare and that unacceptable visibility impairment is experienced throughout the U.S., in multi-state regions, urban areas, and remote federal Class I areas. In many cities having annual mean $PM_{2.5}$ concentrations exceeding annual standard,

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[77] Visual range can be defined as the maximum distance at which one can identify a black object against the horizon sky. It is typically described in miles or kilometers. Light extinction is the sum of light scattering and absorption by particles and gases in the atmosphere. It is typically expressed in terms of inverse megameters (Mm^{-1}), with larger values representing worse visibility. The deciview metric describes perceived visual changes in a linear fashion over its entire range, analogous to the decibel scale for sound. A deciview of 0 represents pristine conditions. Under many scenic conditions, a change of 1 deciview is considered perceptible by the average person.

[78] The Clean Air Act designates 156 national parks and wilderness areas as mandatory Federal Class I areas for visibility protection.

improvements in annual average visibility resulting from the attainment of the annual $PM_{2.5}$ standard are expected to be perceptible to the general population. Based on annual mean monitored $PM_{2.5}$ data, many cities in the Northeast, Midwest, and Southeast as well as Los Angeles would be expected to experience perceptible improvements in visibility if the $PM_{2.5}$ annual standard were attained.

The updated monitoring data and air quality modeling, summarized above and presented in detail in the draft RIA, confirm that the visibility situation identified during the NAAQS review in 1997 is still likely to exist, and it will continue to persist when these proposed standards for nonroad diesel engines take effect. Thus, the determination in the NAAQS rulemaking about broad visibility impairment and related benefits from NAAQS compliance are still relevant.

Furthermore, in setting the $PM_{2.5}$ NAAQS, EPA acknowledged that levels of fine particles below the NAAQS may also contribute to unacceptable visibility impairment and regional haze problems in some areas, and section 169 of the Act provides additional authorities to remedy existing impairment and prevent future impairment in the 156 national parks, forests and wilderness areas labeled as mandatory Federal Class I areas (62 FR 38680-81, July 18, 1997).

In making determinations about the level of protection afforded by the secondary PM NAAQS, EPA considered how the section 169 regional haze program and the secondary NAAQS would function together.[79] Regional strategies are expected to improve visibility in many urban and non-Class I areas as well.

Fine particles may remain suspended for days or weeks and travel hundreds to thousands of kilometers, and thus fine particles emitted or created in one county may contribute to ambient concentrations in a neighboring region.[80]

The 1999-2001 $PM_{2.5}$ monitored values indicate that at least 74 million people live in areas where long-term ambient fine PM levels are at or above 15 $\mu g/m^3$.[81] Thus, at least these populations (plus those who travel to those areas) are experiencing significant visibility

[79] U.S. EPA Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information OAQPS Staff Paper. EPA-452/R-96-013. 1996. Docket Number A-99-06, Documents Nos. II-A-18, 19, 20, and 23. The particulate matter air quality criteria documents are also available at http://www.epa.gov/ncea/partmatt.htm.

[80] Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment for Scientific and Technical Information, OAQPS Staff Paper, EPA-452\R-96-013, July, 1996, at IV-7. This document is available from Docket A-99-06, Document II-A-23.

[81] US EPA Air Quality Data Analysis 1999-2001. Technical Support Document for Regulatory Actions. March 2003.

impairment, and emissions of PM and its precursors from nonroad diesel engines contribute to this impairment.[82]

Because of the importance of chemical composition and size to visibility, we used EPA's Regional Modeling System for Aerosols and Deposition (REMSAD)[83] model to project visibility conditions in 2020 and 2030 in terms of deciview, accounting for the chemical composition of the particles and transport of precursors. Our projections included anticipated emissions from the nonroad diesel engines subject to this proposed rule as well as all other sources.

Based on this modeling, we predict that in 2030, 85 million people (25 percent of the future population) would be living in areas with visibility degradation where fine PM levels are above 15 $\mu g/m^3$ annually.[84] Thus, at least a quarter of the population would experience visibility impairment in areas where they live, work and recreate.

As shown in Table I.C-1, accounting for the different visibility impact of the chemical constituents of the $PM_{2.5}$, in 2030 we expect visibility in the East to be about 20.5 deciviews (or visual range of 50 kilometers) on average, with poorer visibility in urban areas, compared to the average Eastern visibility conditions without man-made pollution of 9.5 deciviews (or visual range of 150 kilometers). Likewise, we expect visibility in the West to be about 8.8 deciviews (or visual range of 162 kilometers) on average in 2030, with poorer visibility in urban areas, compared to the average Western visibility conditions without man-made pollution of 5.3 deciviews (or visual range of 230 kilometers). Thus, the emissions from these nonroad diesel sources, especially SOx emissions that become sulfates in the atmosphere, contribute to future visibility impairment summarized in the table.

Control of nonroad land-based engines emissions, as shown in Table I.C-1, will improve visibility across the nation. Taken together with other programs, reductions from this proposal will help to improve visibility. Control of these emissions in and around areas with PM levels above the annual $PM_{2.5}$ NAAQS will likely improve visibility in other locations such as mandatory Federal Class I areas. Specifically, for a preliminary control option described in the draft RIA Chapter 3.6 that is similar to our proposal, we expect on average for visibility to improve to about 0.33 deciviews in the East and 0.35 deciviews in the West. The improvement

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82 These populations would also be exposed to PM concentrations associated with the adverse health impacts discussed above.

83 Additional information about the Regional Modeling System for Aerosols and Deposition (REMSAD) and our modeling protocols can be found in our Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, document EPA420-R-00-026, December 2000. Docket No. A-2000-01, Document No. A-II-13. This document is also available at http://www.epa.gov/otaq/disel.htm#documents.

84 Technical Memorandum, EPA Air Docket A-99-06, Eric O. Ginsburg, Senior Program Advisor, Emissions Monitoring and Analysis Division, OAQPS, Summary of Absolute Modeled and Model-Adjusted Estimates of Fine Particulate Matter for Selected Years, December 6, 2000, Table P-2. Docket Number 2000-01, Document Number II-B-14.

from our proposal is likely to be similar but slightly smaller than what was modeled due to the differences in emission reductions between the proposal and the modeled scenario.

TABLE I.C-1 – SUMMARY OF MODELED 2030 NATIONAL VISIBILITY CONDITIONS (AVERAGE ANNUAL DECIVIEWS)

Regions[a]	Predicted 2030 Visibility Baseline	Predicted 2030 Visibility with Rule Controls[b]	Change in Annual Average Deciviews
Eastern U.S.	20.54	20.21	0.33
Urban	21.94	21.61	0.33
Rural	19.98	19.65	0.33
Western U.S.	8.83	8.58	0.25
Urban	9.78	9.43	0.35
Rural	8.61	8.38	0.23

Notes:
[a] Eastern and Western Regions are separated by 100 degrees north longitude. Background visibility conditions differ by region. Natural background is 9.5 deciviews in the East and 5.3 in the West.
[b] The results illustrate the type of visibility improvements for the preliminary control option, as discussed in the Draft RIA. The proposal differs based on updated information; however, we believe that the net results would approximate future PM emissions, although we anticipate the visibility improvements would be slightly smaller.

c. Visibility Impairment in Mandatory Federal Class I Areas

The Clean Air Act establishes special goals for improving visibility in many national parks, wilderness areas, and international parks. In the 1990 Clean Air Act amendments, Congress provided additional emphasis on regional haze issues (see CAA section 169B). In 1999, EPA finalized a rule that calls for States to establish goals and emission reduction strategies for improving visibility in all 156 mandatory Federal Class I areas. In that rule, EPA established a “natural visibility” goal, and also encouraged the States to work together in developing and implementing their air quality plans. The regional haze program is focused on long-term emissions decreases from the entire regional emissions inventory comprised of major and minor stationary sources, area sources and mobile sources. The regional haze program is designed to improve visibility and air quality in our most treasured natural areas from these broad sources. At the same time, control strategies designed to improve visibility in the national parks and wilderness areas are expected to improve visibility over broad geographic areas. For mobile sources, there is a need for a Federal role in reduction of those emissions, especially because mobile source engines are regulated primarily at the Federal level.

Because of evidence that fine particles are frequently transported hundreds of miles, all 50 states, including those that do not have mandatory Federal Class I areas, participate in planning, analysis, and, in many cases, emission control programs under the regional haze regulations. Virtually all of the 156 mandatory Federal Class I areas experience impaired visibility, requiring all States with those areas to prepare emission control programs to address it. Even though a given State may not have any mandatory Federal Class I areas, pollution that occurs in that State may contribute to impairment in such Class I areas elsewhere. The rule encourages states to work together to determine whether or how much emissions from sources in a given state affect visibility in a downwind mandatory Federal Class I area.

The regional haze program also calls for states to establish goals for improving visibility in national parks and wilderness areas to improve visibility on the haziest 20 percent of days and to ensure that no degradation occurs on the clearest 20 percent of days (64 FR 35722, July 1, 1999). The rule requires states to develop long-term strategies including enforceable measures designed to meet reasonable progress goals toward natural visibility conditions. Under the regional haze program, States can take credit for improvements in air quality achieved as a result of other Clean Air Act programs, including national mobile source programs.[85]

In the PM air quality modeling described above, we also modeled visibility conditions in the mandatory Federal Class I areas, and we summarize the results by region in Table I.C-2. The information shows that these areas also are predicted to have high annual average deciview levels in the future. Emissions from nonroad land-based diesel engines and locomotive and marine engines contributed significantly to these levels, because these diesel engines represent a sizeable portion of the total inventory of anthropogenic emissions related to $PM_{2.5}$ (as shown in the tables above.). Furthermore, numerous types of nonroad engines may operate in or near mandatory Federal Class I areas (e.g., mining, construction, and agricultural equipment). As summarized in the table, we expect visibility improvements in mandatory Federal Class I areas from the reductions of emissions from nonroad diesel engines subject to this proposed rule.

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[85] In a recent case, American Corn Growers Association v. EPA, 291 F. 3d 1 (D.C. Cir 2002), the court vacated the Best Available Retrofit Technology (BART) provisions of the Regional Haze rule, but the court denied industry's challenge to EPA's requirement that states' SIPs provide for reasonable progress towards achieving natural visibility conditions in national parks and wilderness areas and the "no degradation" requirement. Industry did not challenge requirements to improve visibility on the haziest 20 percent of days. A copy of this decision can be found in Docket A-2000-01, Document IV-A-113.

TABLE I.C-2 – SUMMARY OF MODELED 2030 VISIBILITY CONDITIONS IN MANDATORY FEDERAL CLASS I AREAS (ANNUAL AVERAGE DECIVIEW)

Region[a]	Predicted 2030 Visibility Baseline[b]	Predicted 2030 Visibility with Rule Controls[c]	Change in Annual Average Deciviews
Eastern			
Southeast	21.62	21.38	0.24
Northeast/Midwest	18.56	18.32	0.24
Western			
Southwest	7.03	6.82	0.21
California	9.56	9.26	0.3
Rocky Mountain	8.55	8.34	0.21
Northwest	12.18	11.94	0.24
National Class I Area Average	11.8	11.56	0.24

Notes:
[a] Regions are depicted in Figure VI-5 in the Regulatory Support Document. Background visibility conditions differ by region: Eastern natural background is 9.5 deciviews (or visual range of 150 kilometers) and in the West natural background is 5.3 deciviews (or visual range of 230 kilometers).
[b] The results average visibility conditions for mandatory Federal Class I areas in the regions.
[c] The results illustrate the type of visibility improvements for the preliminary control option, as discussed in the draft RIA. The proposal differs based on updated information; however, we believe that the net results would approximate future PM emissions, although we anticipate the improvements would be slightly smaller.

2. Acid Deposition

Acid deposition, or acid rain as it is commonly known, occurs when SO_2 and NOx react in the atmosphere with water, oxygen, and oxidants to form various acidic compounds that later fall to earth in the form of precipitation or dry deposition of acidic particles.[86] It contributes to damage of trees at high elevations and in extreme cases may cause lakes and streams to become so acidic that they cannot support aquatic life. In addition, acid deposition accelerates the decay

[86] Much of the information in this subsection was excerpted from the EPA document, *Human Health Benefits from Sulfate Reduction*, written under Title IV of the 1990 Clean Air Act Amendments, U.S. EPA, Office of Air and Radiation, Acid Rain Division, Washington, DC 20460, November 1995. Available in Docket A-2000-01, Document No. II-A-32.

of building materials and paints, including irreplaceable buildings, statues, and sculptures that are part of our nation's cultural heritage. To reduce damage to automotive paint caused by acid rain and acidic dry deposition, some manufacturers use acid-resistant paints, at an average cost of $5 per vehicle--a total of $80-85 million per year when applied to all new cars and trucks sold in the U.S.

Acid deposition primarily affects bodies of water that rest atop soil with a limited ability to neutralize acidic compounds. The National Surface Water Survey (NSWS) investigated the effects of acidic deposition in over 1,000 lakes larger than 10 acres and in thousands of miles of streams. It found that acid deposition was the primary cause of acidity in 75 percent of the acidic lakes and about 50 percent of the acidic streams, and that the areas most sensitive to acid rain were the Adirondacks, the mid-Appalachian highlands, the upper Midwest and the high elevation West. The NSWS found that approximately 580 streams in the Mid-Atlantic Coastal Plain are acidic primarily due to acidic deposition. Hundreds of the lakes in the Adirondacks surveyed in the NSWS have acidity levels incompatible with the survival of sensitive fish species. Many of the over 1,350 acidic streams in the Mid-Atlantic Highlands (mid-Appalachia) region have already experienced trout losses due to increased stream acidity. Emissions from U.S. sources contribute to acidic deposition in eastern Canada, where the Canadian government has estimated that 14,000 lakes are acidic. Acid deposition also has been implicated in contributing to degradation of high-elevation spruce forests that populate the ridges of the Appalachian Mountains from Maine to Georgia. This area includes national parks such as the Shenandoah and Great Smoky Mountain National Parks.

A study of emissions trends and acidity of water bodies in the Eastern U.S. by the General Accounting Office (GAO) found that from 1992 to 1999 sulfates declined in 92 percent of a representative sample of lakes, and nitrate levels increased in 48 percent of the lakes sampled.[87] The decrease in sulfates is consistent with emissions trends, but the increase in nitrates is inconsistent with the stable levels of nitrogen emissions and deposition. The study suggests that the vegetation and land surrounding these lakes have lost some of their previous capacity to use nitrogen, thus allowing more of the nitrogen to flow into the lakes and increase their acidity. Recovery of acidified lakes is expected to take a number of years, even where soil and vegetation have not been “nitrogen saturated,” as EPA called the phenomenon in a 1995 study.[88] This situation places a premium on reductions of SOx and especially NOx from all sources, including nonroad diesel engines, in order to reduce the extent and severity of nitrogen saturation and acidification of lakes in the Adirondacks and throughout the U.S.

The SOx and NOx reductions from today's action will help reduce acid rain and acid deposition, thereby helping to reduce acidity levels in lakes and streams throughout the country and help accelerate the recovery of acidified lakes and streams and the revival of ecosystems adversely affected by acid deposition. Reduced acid deposition levels will also help reduce stress

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[87] *Acid Rain: Emissions Trends and Effects in the Eastern United States, US General Accounting Office*, March, 2000 (GOA/RCED-00-47). Available in Docket A-99-06, Document No. IV-G-159.

[88] *Acid Deposition Standard Feasibility Study: Report to Congress*, EPA 430R-95-001a, October, 1995.

on forests, thereby accelerating reforestation efforts and improving timber production. Deterioration of our historic buildings and monuments, and of buildings, vehicles, and other structures exposed to acid rain and dry acid deposition also will be reduced, and the costs borne to prevent acid-related damage may also decline. While the reduction in sulfur and nitrogen acid deposition will be roughly proportional to the reduction in SOx and NOx emissions, respectively, the precise impact of today's action will differ across different areas.

3. Eutrophication and Nitrification

Eutrophication is the accelerated production of organic matter, particularly algae, in a water body. This increased growth can cause numerous adverse ecological effects and economic impacts, including nuisance algal blooms, dieback of underwater plants due to reduced light penetration, and toxic plankton blooms. Algal and plankton blooms can also reduce the level of dissolved oxygen, which can also adversely affect fish and shellfish populations.

In 1999, NOAA published the results of a five year national assessment of the severity and extent of estuarine eutrophication. An estuary is defined as the inland arm of the sea that meets the mouth of a river. The 138 estuaries characterized in the study represent more than 90 percent of total estuarine water surface area and the total number of US estuaries. The study found that estuaries with moderate to high eutrophication conditions represented 65 percent of the estuarine surface area. Eutrophication is of particular concern in coastal areas with poor or stratified circulation patterns, such as the Chesapeake Bay, Long Island Sound, or the Gulf of Mexico. In such areas, the "overproduced" algae tends to sink to the bottom and decay, using all or most of the available oxygen and thereby reducing or eliminating populations of bottom-feeder fish and shellfish, distorting the normal population balance between different aquatic organisms, and in extreme cases causing dramatic fish kills.

Severe and persistent eutrophication often directly impacts human activities. For example, losses in the nation’s fishery resources may be directly caused by fish kills associated with low dissolved oxygen and toxic blooms. Declines in tourism occur when low dissolved oxygen causes noxious smells and floating mats of algal blooms create unfavorable aesthetic conditions. Risks to human health increase when the toxins from algal blooms accumulate in edible fish and shellfish, and when toxins become airborne, causing respiratory problems due to inhalation. According to the NOAA report, more than half of the nation’s estuaries have moderate to high expressions of at least one of these symptoms – an indication that eutrophication is well developed in more than half of U.S. estuaries.

In recent decades, human activities have greatly accelerated nutrient inputs, such as nitrogen and phosphorous, causing excessive growth of algae and leading to degraded water quality and associated impairments of freshwater and estuarine resources for human uses.[89] Since 1970, eutrophic conditions worsened in 48 estuaries and improved in 14. In 26 systems,

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[89] *Deposition of Air Pollutants to the Great Waters, Third Report to Congress*, June, 2000. Available in Docket A-99-06, Document No. IV-A-06.

there was no trend in overall eutrophication conditions since 1970. [90] On the New England coast, for example, the number of red and brown tides and shellfish problems from nuisance and toxic plankton blooms have increased over the past two decades, a development thought to be linked to increased nitrogen loadings in coastal waters. Long-term monitoring in the U.S., Europe, and other developed regions of the world shows a substantial rise of nitrogen levels in surface waters, which are highly correlated with human-generated inputs of nitrogen to their watersheds.

Between 1992 and 1997, experts surveyed by National Oceanic and Atmospheric Administration (NOAA) most frequently recommended that control strategies be developed for agriculture, wastewater treatment, urban runoff, and atmospheric deposition.[91] In its Third Report to Congress on the Great Waters, EPA reported that atmospheric deposition contributes from 2 to 38 percent of the nitrogen load to certain coastal waters.[92] A review of peer reviewed literature in 1995 on the subject of air deposition suggests a typical contribution of 20 percent or higher.[93] Human-caused nitrogen loading to the Long Island Sound from the atmosphere was estimated at 14 percent by a collaboration of federal and state air and water agencies in 1997.[94] The National Exposure Research Laboratory, US EPA, estimated based on prior studies that 20 to 35 percent of the nitrogen loading to the Chesapeake Bay is attributable to atmospheric deposition.[95] The mobile source portion of atmospheric NOx contribution to the Chesapeake Bay was modeled at about 30 percent of total air deposition.[96]

Deposition of nitrogen from nonroad diesel engines contributes to elevated nitrogen levels in waterbodies. The proposed standards for nonroad diesel engines will reduce total NOx emissions by 831,000 tons in 2030. The NOx reductions will reduce the airborne nitrogen

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[90] *Deposition of Air Pollutants to the Great Waters, Third Report to Congress*, June, 2000. Great Waters are defined as the Great Lakes, the Chesapeake Bay, Lake Champlain, and coastal waters. The first report to Congress was delivered in May, 1994; the second report to Congress in June, 1997. Available in Docket A-99-06, Document No. IV-A-06.

[91] Bricker, Suzanne B., et al., *National Estuarine Eutrophication Assessment, Effects of Nutrient Enrichment in the Nation's Estuaries*, National Ocean Service, National Oceanic and Atmospheric Administration, September, 1999. Available in Docket A-99-06, Document No. IV-G-145.

[92] *Deposition of Air Pollutants to the Great Waters, Third Report to Congress*, June, 2000. Available in Docket A-99-06, Document No. IV-A-06.

[93] Valigura, Richard, et al., *Airsheds and Watersheds II: A Shared Resources Workshop*, Air Subcommittee of the Chesapeake Bay Program, March, 1997. Available in Docket A-99-06, Document No. IV-G-144.

[94] *The Impact of Atmospheric Nitrogen Deposition on Long Island Sound*, The Long Island Sound Study, September, 1997.

[95] Dennis, Robin L., *Using the Regional Acid Deposition Model to Determine the Nitrogen Deposition Airshed of the Chesapeake Bay Watershed*, SETAC Technical Publications Series, 1997.

[96] Dennis, Robin L., *Using the Regional Acid Deposition Model to Determine the Nitrogen Deposition Airshed of the Chesapeake Bay Watershed*, SETAC Technical Publications Series, 1997.

deposition that contributes to eutrophication of watersheds, particularly in aquatic systems where atmospheric deposition of nitrogen represents a significant portion of total nitrogen loadings.

4. Polycyclic Organic Matter Deposition

EPA's Great Waters Program has identified 15 pollutants whose deposition to water bodies has contributed to the overall contamination loadings to the these Great Waters.[97] One of these 15 pollutants, a group known as polycyclic organic matter (POM), are compounds that are mainly adhered to the particles emitted by mobile sources and later fall to earth in the form of precipitation or dry deposition of particles. The mobile source contribution of the 7 most toxic POM is at least 62 tons/year and represents only those POM that adhere to mobile source particulate emissions.[98] The majority of these emissions are produced by diesel engines.

The PM reductions from this proposed action will help reduce not only the PM emissions from nonroad diesel engines but also the deposition of the POM adhering to the particles, thereby helping to reduce health effects of POM in lakes and streams, accelerate the recovery of affected lakes and streams, and revive the ecosystems adversely affected.

5. Plant Damage from Ozone

Ground-level ozone can also cause adverse welfare effects. Specifically, ozone enters the leaves of plants where it interferes with cellular metabolic processes. This interference can be manifest either as visible foliar injury from cell injury or death, and/or as decreased plant growth and yield due to a reduced ability to produce food. With fewer resources, the plant reallocates existing resources away from root storage, growth and reproduction toward leaf repair and maintenance. Plants that are stressed in these ways become more susceptible to disease, insect attack, harsh weather and other environmental stresses. Because not all plants are equally sensitive to ozone, ozone pollution can also exert a selective pressure that leads to changes in plant community composition.

Since plants are at the center of the food web in many ecosystems, changes to the plant community can affect associated organisms and ecosystems (including the suitability of habitats that support threatened or endangered species and below ground organisms living in the root zone). Given the range of plant sensitivities and the fact that numerous other environmental factors modify plant uptake and response to ozone, it is not possible to identify threshold values above which ozone is toxic and below which it is safe for all plants. However, in general, the

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[97] *Deposition of Air Pollutants to the Great Waters-Third Report to Congress, June, 2000,* Office of Air Quality Planning and Standards *Deposition of Air Pollutants to the Great Waters-Second Report to Congress*, Office of Air Quality Planning and Standards, June 1997, EPA-453/R-97-011. Available in Docket A-99-06, Document No. IV-A-06.

[98] *The 1996 National Toxics Inventory*, Office of Air Quality Planning and Standards, October 1999.

science suggests that ozone concentrations of 0.10 ppm or greater can be phytotoxic to a large number of plant species, and can produce acute foliar injury responses, crop yield loss and reduced biomass production. Ozone concentrations below 0.10 ppm (0.05 to 0.09 ppm) can produce these effects in more sensitive plant species, and have the potential over a longer duration of creating chronic stress on vegetation that can lead to effects of concern such as reduced plant growth and yield, shifts in competitive advantages in mixed populations, and decreased vigor leading to diminished resistance to pests, pathogens, and injury from other environmental stresses.

Studies indicate that these effects described here are still occurring in the field under ambient levels of ozone. The economic value of some welfare losses due to ozone can be calculated, such as crop yield loss from both reduced seed production (e.g., soybean) and visible injury to some leaf crops (e.g., lettuce, spinach, tobacco) and visible injury to ornamental plants (i.e., grass, flowers, shrubs), while other types of welfare loss may not be fully quantifiable in economic terms (e.g., reduced aesthetic value of trees growing in Class I areas).

As discussed above, nonroad diesel engine emissions of VOCs and NOx contribute to ozone. This proposed rule would reduce ozone and, therefore, help to reduce crop damage and stress from ozone on vegetation. See the draft RIA for a more detailed discussion of the science of these effects.

D. Other Criteria Pollutants Affected by This NPRM

The standards being proposed today would also help reduce levels of other pollutants for which NAAQS have been established: carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). Currently every area in the United States has been designated to be in attainment with the NO_2 NAAQS. As of November 4, 2002, there were 24 areas designated as non-attainment with the SO2 standard, and 14 designated CO non-attainment areas.

The current primary NAAQS for CO are 35 parts per million for the one-hour average and 9 parts per million for the eight-hour average. These values are not to be exceeded more than once per year. Over 22 million people currently live in the 14 non-attainment areas for the CO NAAQS. See the draft RIA for a detailed discussion of the emission benefits of this proposed rule.

Carbon monoxide is a colorless, odorless gas produced through the incomplete combustion of carbon-based fuels. Carbon monoxide enters the bloodstream through the lungs and reduces the delivery of oxygen to the body’s organs and tissues. The health threat from CO is most serious for those who suffer from cardiovascular disease, particularly those with angina or peripheral vascular disease. Healthy individuals also are affected, but only at higher CO levels. Exposure to elevated CO levels is associated with impairment of visual perception, work capacity, manual dexterity, learning ability and performance of complex tasks.

Land-based nonroad engines contributed about one percent of CO from mobile sources in 1996. EPA previously determined that the category of nonroad diesel engines cause or contribute to ambient CO and ozone in more than one non-attainment area (65 FR 76790, December 7, 2000). In that action EPA found that nonroad engines contribute to CO non-attainment in areas such as Los Angeles, Phoenix, Spokane, Anchorage, and Las Vegas. Nonroad land-based diesel engines emitted 927,500 tons of CO in 1996 (1 % of mobile source CO).

E. Emissions From Nonroad Diesel Engines

Emissions from nonroad diesel engines will continue to be a significant part of the emissions inventory in the coming years. In the absence of new emission standards, we expect overall emissions from nonroad diesel engines subject to this proposal to generally decline across the nation for the next 10 to 15 years, depending on the pollutant.[99] Although nonroad diesel engine emissions will decline during this period, this trend will not be enough to adequately reduce the large amount of emissions that these engines contribute. For example, the declines are insufficient to prevent significant contributions to nonattainment of $PM_{2.5}$ and ozone NAAQS, or to prevent widespread exposure to significant concentrations of nonroad engine air toxics. In addition, after the 2010 to 2015 time period we project that this trend reverses and emissions rise into the future in the absence of additional regulation of these engines. (This phenomenon is further described later in this section.) The initial downward trend occurs as the nonroad fleet becomes increasingly dominated over time by engines that comply with existing emission regulations. The upturn in emissions beginning around 2015 results as growth in the nonroad sector overtakes the effect of the existing emission standards.

The engine and fuel standards in this proposal will affect fine particulate matter ($PM_{2.5}$), oxides of nitrogen (NOx), sulfur oxides (SO_2), volatile organic hydrocarbons (VOC), and air toxics. For locomotive, commercial marine vessel (CMV), and recreational marine vessel (RMV) engines, the proposed fuel standards will affect $PM_{2.5}$ and SO_2. CO is not specifically targeted in this proposal but its reductions are discussed in the draft RIA.[100]

Each sub-section within Section II discusses the emissions of a pollutant that the proposal addresses.[101] This is followed by a discussion of the expected emission reductions associated

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[99] As defined here, nonroad diesel engines include land-based, locomotive, commercial marine vessel, and recreational marine engines.

[100] We are proposing only a few minor adjustments of a technical nature to current CO standards.

[101] The estimates of baseline emissions and emissions reductions from the proposed rule reported here for nonroad land-based, recreational marine, locomotive, and commercial marine vessel diesel engines are based on 50 state emissions inventory estimates. However, 50 state emissions inventory data are not available for other emission sources. Thus, emissions estimates for other sources are based on a 48 state inventory that excludes Alaska and Hawaii. The 48 state inventory was done for air quality modeling that EPA uses to analyze regional ozone transport, of which Alaska and Hawaii are not a part. In cases where land-based nonroad diesel engine emissions are summed or compared with other emissions sources, we use a 48 state emissions inventory.

with the proposed standards for land-based nonroad diesel engines.[102] The tables and figures illustrate the Agency's projection of future emissions from nonroad diesel engines for each pollutant.[103] The baseline case represents future emissions from land-based nonroad diesel engines with current standards. The controlled case estimates the future emissions of these engines based on the proposed standards in this notice.

1. $PM_{2.5}$

As described earlier in this section of the preamble, the Agency believes that reductions of diesel $PM_{2.5}$ emissions are needed as part of the Nation's progress toward clean air and to reach attainment of the NAAQS for $PM_{2.5}$. The nonroad engines controlled by this proposal are the major sources of nonroad diesel emissions. Table II.E-1 shows that the $PM_{2.5}$ emissions from land-based nonroad diesels amount to increasingly large percentages of total manmade diesel $PM_{2.5}$ in the years 1996, 2020 and 2030.[104, 105]

Table II.E-1 -- Base-Case National (48 State) Diesel $PM_{2.5}$ (short tons)

Year	**Total Diesel $PM_{2.5}$**	**Nonroad Land-Based Diesel $PM_{2.5}$**	**Nonroad Land-Based Percent of Total Diesel $PM_{2.5}$**
1996	414,000	177,000	43%
2020	206,000	124,000	60%
2030	220,000	140,000	64%

102 For the purpose of this proposal, land-based nonroad diesel engines include engines used in equipment modeled by the draft NONROAD emissions model, except for recreational marine engines. Recreational marine diesel engines are not subject to the exhaust emission standards contained in this proposal but would be affected by the fuel sulfur requirements applicable to locomotive and commercial marine vessel engines.

103 The air quality modeling results described in Sections II.B and II.C use a slightly different emissions inventory based on earlier, preliminary modeling assumptions. Chapter 3 of the draft RIA and the technical support documents fully describe this inventory, as well as the differences between it and the inventory reflecting the proposal.

104 Nitrate and sulfate secondary fine particulate as described in Section II.B and are not included in the values reported here or elsewhere, but are discussed in the Regulatory Impact Analysis, Chapter X.

105 As a function of the available national inventories from other sources, we are only able to present a 48-state inventory. Wherever possible we present a 50-state inventory.

The contribution of land-based nonroad CI engines to $PM_{2.5}$ inventories can be significant, especially in densely populated urban areas.[106] As illustrated in Table II.E.-2, our city-specific analysis of selected metropolitan areas for 1996 and 2020 shows that the land-based nonroad diesel engine contribution to total $PM_{2.5}$ ranges up to 18 percent in 1996 and 19 percent in 2020.[107]

Table II.E-2 -- Baseline Land-Based Nonroad Diesel Percent Contribution to $PM_{2.5}$ Inventories in Selected Urban Areas in 1996 and 2020

MSA, State	Land-Based Nonroad $PM_{2.5}$ Contribution to Total $PM_{2.5}$[a] in 1996	Land-Based Nonroad $PM_{2.5}$ Contribution to Total $PM_{2.5}$[a] in 2020
Atlanta, GA	7%	6%
Boston, MA	18%	18%
Chicago, IL	8%	7%
Dallas-Ft. Worth, TX	13%	10%
Indianapolis, IN	15%	13%
Minneapolis-St. Paul, MN	10%	8%
New York, NY	13%	12%
Orlando, FL	14%	12%
Sacramento, CA	7%	7%
San Diego, CA	9%	7%
Denver, CO	11%	8%
El Paso, TX	15%	19%
Las Vegas, NV	15%	12%
Phoenix-Mesa, AZ	15%	12%
Seattle, WA	7%	7%
National Average[b]	**8%**	**6%**

Notes:
[a] Includes only direct exhaust diesel emissions; see Section II.C for a discussion of secondary fine PM levels.
[b] This is a 48 state national average.

Emissions of $PM_{2.5}$ from land-based nonroad diesel engines based on a 50 state inventory are shown in Table II.E-3, along with our estimates of the reductions in 2020 and 2030 we expect

[106] Construction, industrial, and commercial nonroad diesel equipment comprise most of the land-based nonroad emissions inventory. These types of equipment are more concentrated in urban areas where construction projects, manufacturing, and commercial operations are prevalent. For more information, please refer to the report, "Geographic Allocation of State Level Nonroad Engine Population Data to the County Level," NR-014b, EPA 420-P-02-009.

[107] We selected these cities to show a collection of typical cities spread across the United States in order to compare typical urban inventories with national average ones.

would result from our proposal for a $PM_{2.5}$ exhaust emission standard and changes in the sulfur level in nonroad diesel fuel. For comparison purposes, $PM_{2.5}$ emissions based on lowering nonroad diesel fuel sulfur levels to about 340 ppm in-use[108] (500 ppm maximum) without any other controls are shown, along with the estimated emissions with the proposed $PM_{2.5}$ standard and a sulfur level of 11 ppm in-use (15 ppm maximum). Figure II.E-1 shows our estimate of $PM_{2.5}$ emissions between 2000 and 2030 both without and with the proposed $PM_{2.5}$ standard (along with an assumed sulfur level of 11 ppm in-use, 15 ppm maximum). By 2030, we estimate that $PM_{2.5}$ emissions from this source would be reduced by 86 percent in that year.

[108] This value (340 ppm) represents the average in-use sulfur concentration of fuel produced to meet a 500 ppm sulfur standard. In practice, off-highway equipment will sometimes be refueled with diesel fuel meeting the more stringent highway standard of 15 ppm. Therefore, the actual average in-use sulfur level of the fuel used by off-highway equipment will be somewhat lower than 340 ppm. The emission benefits shown here reflect this lower in-use sulfur level.

Table II.E-3 -- Estimated National (50 State) Reductions in $PM_{2.5}$ Emissions From Nonroad Land-Based, Locomotive, Commercial Marine, and Recreational Marine Diesel Engines

Year	$PM_{2.5}$* Without Rule [short tons]	$PM_{2.5}$ With 500 ppm Fuel Sulfur (340 in-use) and No Other Controls [short tons]	$PM_{2.5}$ Reductions With 500 ppm Fuel Sulfur (340 in-use) and No Other Controls [short tons]	$PM_{2.5}$ With Rule (15 ppm sulfur level, 11 in-use) [short tons]	$PM_{2.5}$ Reductions With Rule (15 ppm sulfur level, 11 in-use) [short tons]
2020	186,000	163,000	100,000	23,000	86,000
2030	205,000	178,000	77,000	27,000	127,000

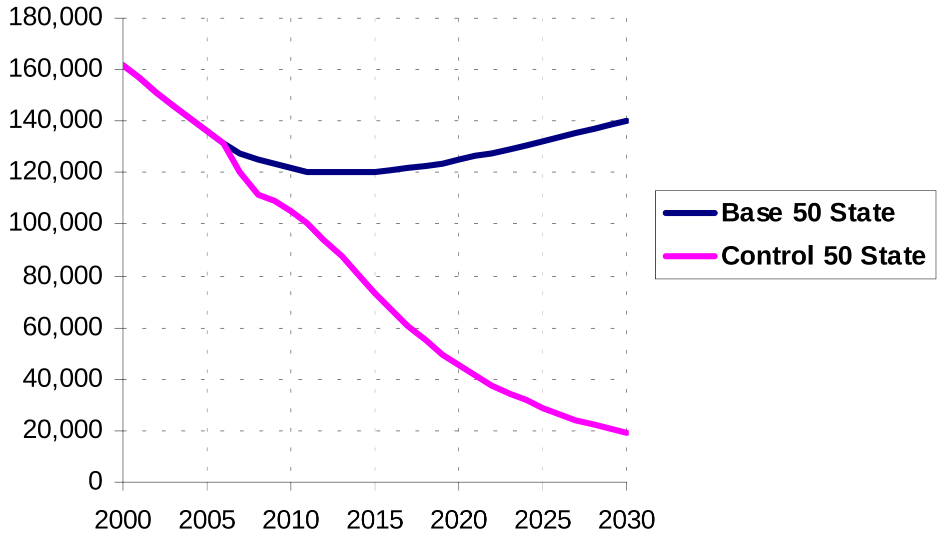

Figure II.E-1: Estimated Reductions in PM2.5 Emissions From Land-Based Nonroad Diesel Engines (tons/year)

Nonroad diesel engines used in locomotives, commercial marine vessels, and recreational marine vessels are not affected by the emission standards of this proposal. $PM_{2.5}$ emissions from these engines would be reduced by the reductions in diesel fuel sulfur for these types of engines from an in-use average of between 2,300 and 2,400 ppm today to an in-use average of about 340 ppm (500 ppm maximum) in 2007. The estimated reductions in $PM_{2.5}$ emissions from these engines based on the proposed change in diesel fuel sulfur are about 6,000 tons in 2020 and 7,000 tons in 2030.[109] For more information on proposed fuel sulfur reductions, please see Chapter 7 of the draft RIA.

2. NOx

Table II.E-4 shows the 50 state estimated tonnage of NOx emissions for 2020 and 2030 without the proposed rule and the estimated tonnage of emissions eliminated with the proposed rule in place. These results are shown graphically in Figure II.E-2. By 2030, we estimate that NOx emissions from these engines will be reduced by 67 percent in that year.

Table II.E.-4 -- Estimated National (50 State) Reductions in NOx Emissions From Nonroad Land-Based Diesel Engines

Calendar Year	NOx Without Rule [short tons]	NOx With Rule [short tons]	NOx Reductions With Rule [short tons]
2020	1,147,000	640,000	507,000
2030	1,239,000	412,000	827,000

[109] These reductions are based on a 50 state emissions inventory estimate.

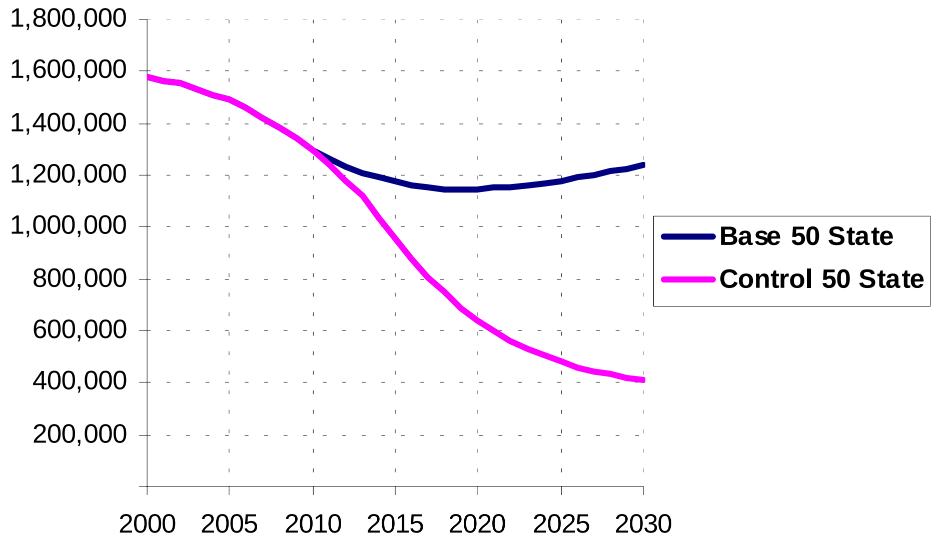

Figure II.E-2: Estimated Reductions in NOx Emissions From Land-Based Nonroad Diesel Engines (tons/year)

Table E.II-5 shows that the engines affected by the proposal emit a significant portion of total NOx emissions in 1996 and 2020, especially in cities. This is not surprising given the high density of these engines operating in urban areas.[110] We selected a variety of cities from across

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[110] Construction, industrial, and commercial nonroad diesel equipment comprise most of the land-based nonroad emissions inventory. These types of equipment are more concentrated in urban areas where construction projects, manufacturing, and commercial operations are prevalent. For more information, please refer to the report, "Geographic Allocation of State Level Nonroad Engine Population Data to the County Level," NR-014b, EPA 420-

the nation and found that these engines contribute up to 14 percent of the total NOx inventories in 1996 and as much as 20 percent to total NOx inventories in 2020.[111]

Table II.E-5 -- Baseline Land-Based Nonroad Diesel Percent Contribution to NOx Inventories in Selected Urban Areas in 2020

MSA, State	Land-Based NR NOx as Percentage of Total NOx in 1996	Land-Based NR NOx as Percentage of Total NOx in 2020
Atlanta, GA	5%	7%
Boston, MA	14%	19%
Chicago, IL	6%	7%
Dallas-Fort Worth, TX	10%	13%
Indianapolis, IN	8%	12%
Minneapolis-St. Paul, MN	6%	6%
New York, NY	11%	20%
Orlando, FL	10%	13%
Sacramento, CA	10%	19%
San Diego, CA	9%	14%
Denver, CO	8%	8%
El Paso, TX	8%	15%
Las Vegas, NV-AZ	11%	12%
Phoenix-Mesa, AZ	9%	11%
Seattle, WA	8%	11%
National Average[a]	**6%**	**7%**

Notes:
[a] This is a 48 state national average.

3. SO_2

We estimate that land-based nonroad, CMV, RMV, and locomotive diesel engines emitted about 227,000 tons of SO_2 in 1996, accounting for about 30 percent of the SO_2 from mobile sources (based on a 48 state inventory). With no reduction in diesel fuel sulfur levels, we estimate that these emissions will continue to increase, accounting for about 60 percent of mobile source SO_2 emissions by 2030.

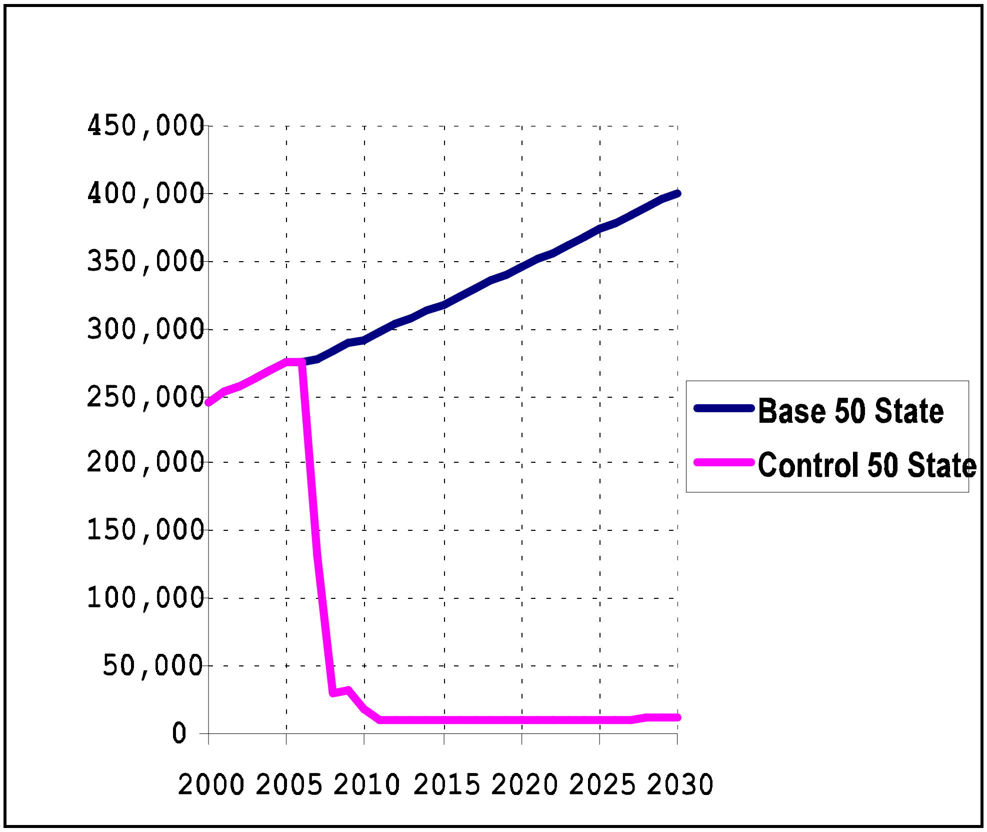
As part of this proposal, sulfur levels in fuel would be significantly reduced, leading to large reductions in nonroad diesel SO_2 emissions. By 2007, the sulfur in diesel fuel used by all nonroad diesel engines would be reduced from the current average in-use level of between 2,300

P-02-009.

[111] We selected these cities to show a collection of typical cities spread across the United States in order to compare typical urban inventories with national average ones.

and 2,400 ppm to an average in-use level of about 340 ppm with a maximum level of 500 ppm. By 2010, the sulfur in diesel fuel used by land-based nonroad engines would be reduced to an average in-use level of 11 ppm with a maximum level of 15 ppm. The sulfur in diesel fuel used by locomotives, CMVs, and RMVs would remain at an average in-use level of about 340 ppm. Figure II.E-3 shows the estimated reductions from these sulfur changes. For more information on this topic, please see Chapter 7 of the RIA.[112]

Figure II.E-3 -- Estimated SO2 Reductions From Reducing Diesel Sulfur For Land-Based Nonroad Engines, CMVs, RMVs, and Locomotives (tons/year)



[112] Under this proposal, the introduction of 340 ppm (approximate average in-use level, 500 ppm maximum)) sulfur diesel fuel for all nonroad diesel engines would take place in June of 2007. The introduction of 11 ppm sulfur diesel fuel (average in-use, 15 ppm maximum) for land-based nonroad engines would take place in June 2010.

Table II.E-6 shows 50 state estimates of total SO_2 emissions without the proposed rule and how SO_2 emissions would be reduced by the diesel fuel sulfur reductions in 2020 and 2030. Lowering diesel fuel sulfur to a maximum of 500 ppm (340 ppm in-use) for CMV, locomotive and land-based nonroad engines would result in a reduction of about 360,000 tons/year of SO_2 in 2030. Lowering diesel fuel sulfur to a maximum of 500 ppm (340 ppm in-use) for CMV and locomotive engines and a maximum of 15 ppm (11 ppm in-use) for land-based nonroad engines would result in a reduction of about 390,000 tons of SO_2 in 2030.

TABLE II.E-6 -- ESTIMATED NATIONAL (50 STATE) EMISSIONS OF LAND-BASED NONROAD, LOCOMOTIVE, COMMERCIAL MARINE VESSEL, AND RECREATIONAL MARINE VESSEL SO_2 EMISSIONS FROM LOWERING DIESEL FUEL SULFUR LEVELS

Year	Total SO_2 Emissions at 2400 ppm Sulfur Without Proposed Rule [short tons]	500 ppm Sulfur (340 ppm in-use) Locomotives, CMVs, RMVs[a] [short tons]	500 ppm Sulfur (340 in-use) Land-Based Nonroad [short tons]	15 ppm Sulfur (11 ppm in-use) Land-Based Nonroad [short tons]
1996	229,000			
2020	345,000	9,000	26,000	1,000
2030	401,000	10,000	30,000	1,000

Notes:
[a] CMV = commercial marine vessels, RMV = Recreational marine vessels

4. VOC and Air Toxics

Based on a 48 state emissions inventory, we estimate that land-based nonroad diesel engines emitted over 221 thousand tons of VOC in 1996. Between 1996 and 2030, we estimate that land-based nonroad diesel engines will contribute about 2 to 3 percent to mobile source VOC emissions. Without further controls, land-based nonroad diesel engines will emit over 97 thousand tons/year of VOC in 2020 and 2030 nationally.[113]

Tables II.E-7 shows our projection of the reductions in 2020 and 2030 for VOC emissions that we expect from implementing the proposed NMHC standards. This estimate is based on a 50 state emissions inventory. By 2030, VOC reductions would be reduced by 30 percent.

[113] VOC emissions remain about the same in 2030 as 2020 because while nonroad diesel emission factors decrease and newer engines continue to be introduced into the fleet, the engine/equipment population continues to increase. The increase in engine/equipment population offsets the effect of decreasing emission factors.

TABLE II.E-7 -- ESTIMATED NATIONAL (50 STATE) REDUCTIONS IN VOC EMISSIONS FROM NONROAD LAND-BASED DIESEL ENGINES

Calendar Year	VOC Without Rule [short tons]	VOC With Rule [short tons]	VOC Reductions With Rule [short tons]
2020	97,000	79,000	18,000
2030	98,000	68,000	30,000

Air toxics pollutants are in VOCs and are included in the total land-based nonroad diesel VOC emissions estimate. We base these numbers on the assumption that air toxic emissions are a constant fraction of hydrocarbon exhaust emissions.

Although we are not proposing any specific gaseous air toxics standards, air toxics emissions would nonetheless be reduced through NMHC standards included in the proposed rule. By 2030, we estimate that emissions of air toxics pollutants, such as benzene, formaldehyde, acetaldehyde, 1,3-butadiene, and acrolein, would be reduced by 30 percent from land-based nonroad diesel engines. For specific air toxics reductions please see Chapter 3 of the RIA. In Section II.B.2 we discuss the health effects of these pollutants.

III. Nonroad Engine Standards

In this section we describe the nonroad diesel emission standards we are proposing in order to address the serious air quality problems discussed in Section II. Specifically, we discuss:

- The Clean Air Act and why we are proposing new emission standards.
- The technology opportunity for nonroad diesel emissions control.
- Our proposed engine standards, and our proposed schedule for implementing them.
- Proposals for supplemental test procedures and standards to help control emissions during transient operating modes and engine start-up.
- Proposals to help ensure robust emissions control in use.
- The feasibility of the proposed standards (in conjunction with the proposed low-sulfur nonroad diesel fuel requirement discussed in Section IV).
- How diesel fuel sulfur affects an engine’s ability to meet the proposed standards.
- Plans for a future reassessment of the technology needed to comply with proposed standards for engines below 75 hp.

Additional proposed provisions for engine and equipment manufacturers are discussed in detail in Section VII. Briefly, these include changes to our engine manufacturer averaging, banking, and trading (ABT) program, changes to our transition program for equipment manufacturers, special provisions to aid small businesses in implementing our requirements, and an incentive program to encourage innovative technologies and the early introduction of new technologies.

We welcome comment on all facets of this discussion, including the levels and timing of the proposed emissions standards and our assessment of technological feasibility, as well as on the supporting analyses contained in the Draft Regulatory Impact Analysis (RIA). We also request comment on the timing of the proposed diesel fuel standard in conjunction with these proposed emission standards. We ask that commenters provide any technical information that supports the points made in their comments.

A. Why are We Setting New Engine Standards?

1. The Clean Air Act and Air Quality

We believe that Agency action is needed to address the air quality problems discussed in Section II. We are therefore proposing new engine standards and related provisions under sections 213(a)(3) and (4) of the Clean Air Act which, among other things, direct us to establish (and from time to time revise) emission standards for new nonroad diesel engines. Because emissions from these engines contribute greatly to a number of serious air pollution problems, especially the health and welfare effects of ozone, PM, and air toxics, we believe that the air quality need for stringent nonroad diesel standards is well established. This, and our belief that a significant degree of emission reduction from these engines is achievable through the application of diesel emission control technology that will be available in the lead time provided (giving appropriate consideration to cost, noise, safety, and energy factors as required by the Act), along with coordinated reductions in nonroad diesel fuel sulfur levels, leads us to believe that these new emission standards are warranted and appropriate.

We also believe that the proposed engine standards are consistent with the Clean Air Act Section 213 requirements on availability of technology and appropriate lead time. The basis for our conclusion is described in this section and in the Draft RIA.

2. The Technology Opportunity for Nonroad Diesel Engines

Substantial progress has been made in recent years in controlling diesel exhaust emissions through the use of robust, high-efficiency catalytic devices placed in the exhaust system. Particularly promising are the catalytic soot filter or particulate trap for PM and hydrocarbon control, and the NOx adsorber. These technologies are expected to be applied to highway heavy-duty diesel engines (HDDEs) beginning in 2007 to meet stringent new standards for these engines. The final EPA rule establishing those standards contains extensive discussion of how these devices work, how effective they are at reducing emissions, and what their limitations are, particularly their dependence on very-low sulfur diesel fuel to function properly (66 FR 5002, January 18, 2001; see especially Section III of the preamble starting at 5035). Reviews of ongoing progress in the development of these technologies have recently been performed by EPA and by an independent review panel.[114, 115] These reviews found that significant progress has been made since the final rule was published, reinforcing our confidence that the highway engine standards can be met. (Our consideration of these highway engine standards is consistent with the requirement in Clean Air Act section 213(a)(3) that EPA consider nonroad engine standards equivalent in stringency to those adopted for comparable highway engines regulated under section 202 of the Act.)

Although there are important differences, nonroad diesel engines operate fundamentally like heavy-duty highway diesel engines. In fact, many nonroad engine designs are derived from highway engine platforms. We believe that, given the availability of nonroad diesel fuel meeting our proposed 15 ppm maximum sulfur requirement and adequate development lead time, nonroad diesel engines can be designed to successfully employ the same high-efficiency exhaust emission control technologies now being developed for highway use. Indeed, some nonroad diesel applications, such as in underground mining, have pioneered the use of similar technologies for many years. These technologies, the experience gained with them in nonroad applications, the issues involved in transferring technology from highway to nonroad applications, and the appropriate standards and test procedures for this nonroad Tier 4 program are discussed in detail in the remainder of this section.

B. What Engine Standards are We Proposing?

1. Exhaust Emissions Standards

The PM, NOx, and NMHC emissions standards being proposed for nonroad diesel engines are summarized in Figures III.B-1 and 2. We are also making minor adjustments to CO standards as discussed in Section III.B.1.f. All of these standards would apply to covered nonroad engines over the useful life periods specified in our regulations, except where temporary in-use compliance margins would apply as discussed in Section VII.J.[116] We are not proposing changes to the current useful life periods because we do not have any relevant new information that would lead us to propose changes. However, we do ask for comment on whether or not changes are warranted and, if so, on what the useful life periods should be. The testing requirements by which compliance with the standards would be measured are discussed in

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[114] "Highway Diesel Progress Review", U.S. EPA, June 2002. EPA420-R-02-016. (www.epa.gov/air/caaac/dieselreview.pdf).

[115] "Meeting Technology Challenges For the 2007 Heavy-Duty Highway Diesel Rule", Final Report of the Clean Diesel Independent Review Subcommittee, Clean Air Act Advisory Committee, October 30, 2002. (www.epa.gov/air/caaac/diesel/finalcdirpreport103002.pdf).

[116] The useful life for engines $\geq$50 hp is 8,000 hours or 10 years, whichever occurs first. For engines <25 hp, and for 25-50 hp engines that operate at constant speed at or above 3000 rpm, it is 3000 hours or 5 years. For other 25-50 hp engines, it is 5000 hours or 7 years.

Section III.C. In addition we are proposing new "not-to-exceed" (NTE) emission standards and associated test procedures to help ensure robust control of emissions in use. These standards are discussed as part of a broader outline of proposed NTE provisions in Sections III.D and VII.G.

FIGURE III.B-1 – PROPOSED PM STANDARDS (G/BHP-HR) AND SCHEDULE

Engine Power	Model Year					
	2008	2009	2010	2011	2012	2013
hp < 25 (kW < 19)	0.30 [a]					
25 ≤ hp < 75 (19 ≤ kW < 56)	0.22 [b]					0.02
75 ≤ hp < 175 (56 ≤ kW < 130)					0.01	
175 ≤ hp ≤ 750 (130 ≤ kW ≤ 560)				0.01		
hp > 750 (kW > 560)				0.01 [c]		

Notes:

[a] For air-cooled, hand-startable, direct injection engines under 11 hp, a manufacturer may instead delay implementation until 2010 and demonstrate compliance with a less stringent PM standard of 0.45 g/bhp-hr, subject also to additional provisions discussed in Section III.B.1.d.i.

[b] A manufacturer has the option of skipping the 0.22 g/bhp-hr PM standard for all 50-75 hp engines; the 0.02 g/bhp-hr PM standard would then take effect one year earlier for all 50-75 hp engines (in 2012).

[c] 50% of a manufacturer's U.S.-directed production must meet the 0.01 g/bhp-hr PM standard in this model year. In 2014, 100% must comply.

FIGURE III.B-2 – PROPOSED NOx AND NMHC STANDARDS AND SCHEDULE

Engine Power	Standard (g/bhp-hr)	
	NOx	NMHC
$25 \leq hp < 75$ ($19 \leq kW < 56$)	3.5 NMHC+NOx [a]	
$75 \leq hp < 175$ ($56 \leq kW < 130$)	0.30	0.14
$175 \leq hp \leq 750$ ($130 \leq kW \leq 560$)	0.30	0.14
$hp > 750$ ($kW > 560$)	0.30	0.14

Engine Power	Phase-in Schedule			
	2011	2012	2013	2014
$25 \leq hp < 75$ ($19 \leq kW < 56$)			100%	
$75 \leq hp < 175$ ($56 \leq kW < 130$)		50% [b]	50% [b]	100% [b]
$175 \leq hp \leq 750$ ($130 \leq kW \leq 560$)	50%	50%	50%	100%
$hp > 750$ ($kW > 560$)	50%	50%	50%	100%

Notes:
Percentages are U.S.-directed production required to comply with the Tier 4 standards in the indicated model year.
[a] This is the existing Tier 3 combined NMHC+NOx standard level for the 50-75 hp engines in this category; in 2013 it would apply to the 25-50 hp engines as well.
[b] Manufacturers may use banked Tier 2 NMHC+NOx credits to demonstrate compliance with the proposed 75-175 hp engine NOx standard in this model year. Alternatively, manufacturers may forego this special banked credit option and instead meet an alternative phase-in requirement in 2012, 2013, and part of 2014. See Section III.B.1.b.

The proposed long-term 0.01 and 0.02 g/bhp-hr Tier 4 PM standards for >75 hp and 25-75 hp engines, respectively, combined with the fuel change and proposed new requirements to ensure robust control in the field, represent a reduction of over 95% from in-use levels expected with Tier 2/Tier 3 engines.[117] The proposed 0.30 g/bhp-hr Tier 4 NOx standard for >75 hp engines represents a NOx reduction of about 90% from in-use levels expected with Tier 3 engines. The basis for the proposed standard levels is presented in Section III.E.

[117] Note that we are grouping all standards proposed in this rule under the general designation of "Tier 4 standards", including those proposed to take effect in 2008. As a result, there are no "Tier 3" standards in the multi-tier nonroad program for engines below 50 hp or above 750 hp.

a. Standards Timing

The timing of the Tier 4 NOx, PM, and NMHC standards is closely tied to the proposed timing of fuel quality changes discussed in Section IV, in keeping with the systems approach we are taking for this program. The earliest Tier 4 standards would take effect in model year 2008, in conjunction with the introduction of 500 ppm maximum sulfur nonroad diesel fuel in mid-2007. This fuel change serves a dual environmental purpose. First, it provides a large immediate reduction in PM emissions for the existing fleet of engines in the field. Second, its widespread availability by the end of 2007 aids engine designers in employing emission controls capable of achieving the proposed standards for model year 2008 and later engines; this is because the performance and durability of such technologies as exhaust gas recirculation (EGR) and diesel oxidation catalysts is improved by lower sulfur fuel.[118] The reduction of sulfur in nonroad diesel fuel will also provide sizeable economic benefits to machine operators as it will extend oil change intervals and reduce wear and corrosion (see Section V).

We are not, however, proposing new 2008 standards for engines at or above 100 hp because these engines are subject to existing Tier 3 NMHC+NOx standards (Tier 2 for engines above 750 hp) in 2006 or 2007. Setting new 2008 standards would provide only one or two years before another round of design changes would have to be made for Tier 4. Engines between 50-100 hp also have a Tier 3 NMHC+NOx standard, but it takes effect in 2008, providing an opportunity to coordinate with Tier 4 to provide the desired pull-ahead of PM control. We believe that we can accomplish this PM pull-ahead without hampering manufacturers' Tier 3 compliance efforts by providing two Tier 4 compliance options for 50-75 hp engines. This reflects the splitting of the current 50-100 hp category of engines to match the new rated power[119] categories shown in Figures III.B-1 and 2. We are proposing to provide manufacturers with the option to skip the Tier 4 2008 PM standard (see Figure III-B.1) and instead to focus design efforts on introducing PM filters for these engines one year earlier, in 2012. This option would ensure that a manufacturer's Tier 3 NMHC+NOx compliance plans are not complicated by having to meet a new Tier 4 PM standard in the same timeframe, if that were to become a concern for a manufacturer.

We are concerned that this optional approach for 50-75 hp engines might be abused by equipment manufacturers whose engine suppliers opt not to meet the PM pull-ahead standard in 2008, but who then switch engine suppliers to avoid PM filter-equipped engines in 2012. We are therefore proposing that an equipment manufacturer making a product with engines not meeting the pull-ahead standard in any of the years 2008-2011, must use engines in that product in 2012 meeting the 0.02 g/bhp-hr PM standard; that is, from the same engine manufacturer or from another engine manufacturer choosing the same compliance option. This restriction would not apply if the 2008-2011 engines at issue are being produced under the equipment manufacturer flexibility provisions discussed in Section VII.B. Also, we would not prohibit an equipment

[118] "Nonroad Diesel Emissions Standards Staff Technical Paper", EPA420-R-01-052, October 2001.

[119] The term rated power is used in this document to mean the maximum power of an engine. See Section VII.L for more information about how the maximum power of an engine is determined.

manufacturer who is using non-pull-ahead engines in 2008-2011 from making use of available equipment manufacturer flexibility provisions in 2012 or later. That is, they could continue to use Tier 3 engines in 2012 that are purchased under these provisions; they would, however, still be subject to the above-described restriction on switching manufacturers. We solicit comment on whether this restriction should have a numerical basis (e.g., the "no switch" restriction in 2012 applies to the same percentage of 50-75 hp machines produced with non-pull-ahead engines in 2008-2011) to avoid further abuse by equipment manufacturers who redefine their product models to dodge the requirement, and on other suggestions for dealing with this concern.

Note that we are not proposing the optional 2008 PM standard for engines between 75 and 100 hp, even though they, like the 50-75 hp engines, are subject to a 2008 Tier 3 standard. This is because we believe that these larger engines, proposed to be grouped into a new 75-175 hp category, would be subject to stringent new PM and NOx standards beginning in 2012, and adding a 2008 PM component to this program for a quarter of this 75-175 hp range would complicate manufacturers' efforts to comply in 2012 for the overall category.

We view the 2008 portion of the Tier 4 program as highly important because it provides substantial PM and SOx emissions reductions during the several years prior to 2011. Initiating Tier 4 in 2008 also fits well with the lead time, stability, cost, and technology availability considerations of the overall program.[120] Initiating the Tier 4 standards in 2008 would provide three to four years of stability after the start of Tier 2 for engines under 50 hp. As mentioned above, it also coincides with the start date of Tier 3 NOx+NMHC standards for engines between 50 and 75 hp and so introduces no stability issues for these engines. As the Agency expects to finalize this rule in early 2004, the 2008 start date provides almost 4 years of lead time to accomplish redesign and testing. The evolutionary character of the 2008 standards, based as they are on proven technologies, and the fact that some certified engines already meet these standards as discussed in Section III.E leads us to conclude that this will provide adequate lead time.

The second fuel change, to 15 ppm maximum sulfur in mid-2010, and the related engine standards that begin to phase-in in the 2011 model year, provide the large majority of the environmental benefits of the program. These standards are also timed to provide adequate lead time for manufacturers, and to phase in over time to allow for the orderly transfer of technology from the highway sector. We believe that the high-efficiency exhaust emission technologies being developed to meet our 2007 emission standards for heavy-duty highway diesel engines can be adapted to nonroad diesel applications. The engines for which we believe this adaptation from highway applications will be most straightforward are those in the over 175 hp power range, and thus under our proposal these engines would be subject to new standards requiring

[120] Section 213(b) of the Clean Air Act does not specify a minimum lead time period, nor does it mandate a set minimum period of stability for the standards (differing in these respects from the comparable provision section (202(a)(3)(C)) applicable to highway engines). However, in considering the amount of lead time and stability provided, EPA takes into consideration the need to avoid disruptions in the engine and equipment manufacturing industries caused by redesign mandates that are too frequent or too soon after a final rulemaking. These are appropriate factors to consider in determining "the lead time necessary to permit the development and application of the requisite technology", and are part of taking cost into consideration, as required under section 213 (b).

high-efficiency exhaust emission controls as soon as the 15 ppm sulfur diesel fuel is widely available, that is, in the 2011 model year. Engines between 75 and 175 hp would be subject to the new standards in the following model year, 2012, reflecting the greater effort involved in adapting highway technologies to these engines. Lastly, engines between 25 and 75 hp would be subject to the new PM standard in 2013, reflecting the even greater challenge of adapting PM filter technology to these engines which typically do not have highway counterparts. There are additional phase-in provisions discussed in Section III.B.1.b aimed at further drawing from the highway technology experience.

In addition to addressing technology transfer, this approach reflects the need to distribute the workload for engine and equipment redesign over three model years, as was provided for in Tier 3. Overall, this approach provides 4 to 6 years of real world experience with the new technology in the highway sector, involving millions of engines (in addition to the several additional years provided by demonstration fleets already on the road), before the new standards take effect.

b. Phase-In of NOx and NMHC Standards

Because the Tier 4 NOx emissions control technology, like PM control technology, is expected to be derived from technology first introduced in highway HDDEs, we believe that the implementation of the Tier 4 NOx standard should follow the pattern we adopted for the highway program. This will help to ensure a focused, orderly development of robust high-efficiency NOx control in the nonroad sector and will also help to ensure that manufacturers are able to take maximum advantage of the highway engine development program, with resulting cost savings. The heavy-duty highway rule allows for a gradual phase-in of the NOx and NMHC requirements over multiple model years: 50 percent of each manufacturer's U.S.-directed production volume must meet the new standard in 2007-2009, and 100 percent must do so by 2010. We also provided flexibility for highway engine manufacturers to meet that program's environmental goals by allowing somewhat less-efficient NOx controls on more than 50% of their production before 2010 via emissions averaging. Similarly, we are proposing to phase in the NOx standards for nonroad diesels over 2011-2013 as indicated in Figure III.B-2, based on compliance with the Tier 4 standards for 50% of a manufacturer's U.S.-directed production in each power category at or above 75 hp in each phase-in model year.

With a NOx phase-in, all manufacturers are able to introduce their new technologies on a limited number of engines, thereby gaining valuable experience with the technology prior to implementing it on their entire product line. In tandem with the equipment manufacturer transition program discussed in Section VII.B, the phase-in ensures timely progress to the Tier 4 standards levels while providing a great degree of implementation flexibility for the industry.

We are proposing this "percent of production phase-in" to take maximum advantage of the highway program technology development. It adds a new dimension of implementation flexibility to the staggered "phase-in by power category" used in the nonroad program for Tiers 1,2 and 3 which, though structured to facilitate technology development and transfer, is more aimed at spreading the redesign workload. Because the Tier 4 program would involve substantial challenges in addressing both technology development and redesign workload, we believe that incorporating both of these phase-in mechanisms into the proposed program is warranted, resulting in the coordinated phase-in plan shown in Figure III.B-2. Note that this results in our proposing that new NOx requirements for 75-175 hp engines be deferred for the first year of the 2011-2013 general phase-in, in effect creating a 50-50% phase-in in 2012-2013 for this category. This then staggers the Tier 4 start years by power category as in past tiers: 2011 for engines at or above 175 hp, 2012 for 75-175 hp engines, and 2013 for 25-75 hp engines (for which no NOx adsorber-based standard and thus no percentage phase-in is being proposed), while still providing a production-based phase-in for advanced NOx control technologies.

We believe that the 75-175 hp category of engines and equipment may involve added workload challenges for the industry to develop and transfer technology. We note that this category, though spanning only 100 hp, represents a great diversity of applications, and comprises a disproportionate number of the total nonroad engine and machine models. Some of these engines, though having characteristics comparable to many highway engines such as turbocharging and electronic fuel control, are not directly derived from highway engine platforms and so are likely to require more development work than larger engines to transfer emission control technology from the highway sector. Furthermore, the engine and equipment manufacturers have greatly varying market profiles in this category, from focused one- or two-product offerings to very diverse product lines with a great many models. We are interested in providing useful flexibility for a wide range of companies in implementing the Tier 4 standards, while keeping a priority on bringing PM emissions control into this diverse power category as quickly as possible.

We are therefore proposing two compliance flexibility provisions just for this category. First, we propose to allow manufacturers to use NMHC+NOx credits generated by Tier 2 engines over 50 hp (in addition to any other allowable credits) to demonstrate compliance with the Tier 4 requirement for 75-175 hp engines in 2012, 2013, and 2014 only. This would not otherwise be allowed, for reasons explained in Section VII.A. These Tier 2 credits would be subject to the power rating conversion already established in our ABT program, and to the 20% credit adjustment we are proposing for use of NMHC+NOx credits as NOx credits. (See Section VII.A.)

Second, we realize that some manufacturers, especially those with limited product offerings, may not have sufficient banked credits available to them to benefit from this special flexibility, and so we are also proposing an alternative flexibility provision. A manufacturer may optionally forego the Tier 2 banked credit use provision described above, and instead demonstrate compliance with a reduced phase-in requirement for NOx and NMHC. Use of credits other than banked Tier 2 credits would still be allowed, in accordance with the other ABT program provisions. In no case could the phase-in compliance demonstration drop below 25% in each of 2012, 2013, and the first 9 months of 2014, except as allowed under the "good faith projection deficit" provision discussed in Section VII.D. Full compliance (100% phase-in) with the Tier 4 standards would need to be demonstrated in the last 3 months of 2014 and thereafter.

In addition, a manufacturer using this reduced phase-in option would not be allowed to generate credits from engines in this power category in 2012, 2013, and the first 9 months of 2014, except for use in averaging within this power category only (no banking or trading, or averaging with engines in other power categories). This restriction would apply throughout this period even if the reduced phase-in option is exercised during only a portion of this period. We believe that this ABT restriction is important to avoid potential abuse of the added flexibility allowance, considering that larger engine categories will be required to demonstrate substantially greater compliance levels with the 0.30 g/bhp-hr NOx standard several years earlier than engines built under this option. The restriction should be no burden to manufacturers, as only those using the option would be subject to it, and the production of credit-generating engines would be contrary to the option's purpose.

We are proposing to phase in the Tier 4 NMHC standard with the NOx standard, as is being done in the highway program. Engines certified to the new NOx requirement would be expected to certify to the NMHC standard as well. The "phase-out" engines (the 50 percent not certified to the new Tier 4 NOx and NMHC standards) would continue to be certified to the applicable Tier 3 NMHC+NOx standard. As discussed in Section III.E, we believe that the NMHC standard is readily achievable through the application of PM traps to meet the PM standard, which for most engines does not involve a phase-in. However, in the highway program we chose to phase in the NMHC standard with the NOx standard for administrative reasons, to simplify the phase-in under the percent-of-production approach taken there, thus avoiding subjecting the "phase-out" engines to separate standards for NMHC and NMHC+NOx. The same reasoning applies here because, as in the highway program, the previous-tier standards are combined NMHC+NOx standards.

Because of the tremendous variety of engine sizes represented in the nonroad diesel sector, we are proposing that the 50 percent phase-in requirement be met separately in each of the three power categories for which a phase-in is proposed (75-175 hp, 175-750 hp, and >750 hp).[121] For example, a manufacturer that produces 1000 engines for the 2011 U.S. market in the 175 to 750 hp range would have to demonstrate compliance to the proposed NOx and NMHC standards on at least 500 of these engines, regardless of how many complying engines the manufacturer produces in other hp categories. (Note, however, that we would allow averaging of emissions across these engine category cutpoints through the use of power-weighted ABT program credits, as provided for in the existing nonroad diesel engine program.) We believe that this restriction reflects the availability of emissions control technology, and is needed to avoid erosion of environmental benefits that might occur if a manufacturer with a diverse product offering were to meet the phase-in with relatively low cost smaller engines, thereby delaying compliance on larger engines with much higher lifetime emissions potential. Even so, the horsepower ranges for these power categories are fairly broad, so this restriction allows ample freedom to manufacturers to structure compliance plans in the most cost-effective manner. We could as well choose to handle this concern by weighting complying engines by horsepower, as we do in the ABT program, but

[121] Note proposed exceptions to the 50 percent requirements during the phase-in model years discussed in Sections VII.D and VII.E. These deal with differences between a manufacturer's actual and projected production levels, and with incentives for early or very low emission engine introductions.

we believe that creating a simple phase-in structure based simply on counting engines, as we did in the highway HDDE rule, avoids unnecessary complexity and functional overlap with ABT.

c. Rationale for Restructured Horsepower Categories

We are proposing to regroup the power categories in the proposed Tier 4 program compared to the previous tiers of standards.[122] We are doing so because this will more closely match the degree of challenge involved in transferring advanced emissions control technology from highway engines to nonroad engines. For a variety of reasons, highway engines have in the past been equipped with new emission control technologies some years before nonroad engines. As a result, the nonroad engine platforms that are directly derived from highway engine designs in turn become the lead application point for the migration of emission control technologies into the nonroad sector. Smaller and larger nonroad engines, as well as similar-sized engines that cannot directly use a highway base engine (such as farm tractor engines that are structurally part of the tractor chassis), may then employ these technologies after additional lead time for needed adaptation. This progression has been reflected in EPA standards-setting activity to date, especially in implementation schedules, in which the earliest standards are applied to engines in the most “highway-like” power categories.

Although there is not an abrupt power cutpoint above and below which the highway-derived nonroad engine families do and do not exist, we believe that 75 hp is a more appropriate cutpoint for this purpose than either of the closest previously adopted power category cutpoints of 50 or 100 hp. These two cutpoints were first adopted in a 1994 final rule that chose them in order to establish categories for a staggered implementation schedule designed to spread out development costs (59 FR 31306, June 17, 1994). Nonroad diesels produced today with rated power above 75 hp (up to several hundred hp) are mostly variants of nonroad engine platforms with four or more cylinders and per-cylinder displacements of one liter or more. These in turn are derived from or are similar to heavy-duty highway engine platforms. Even where nonroad engine models above 75 hp are not so directly derived from highway models, they typically share many common characteristics such as displacements of one liter per cylinder or more, direct injection fueling, turbocharging, and, increasingly, electronic fuel injection. These common features provide key building blocks in transferring high-efficiency exhaust emission control technology from highway to similar nonroad diesel engines. We have discussed this matter with relevant engine manufacturers, and we are confident based on these discussions that 75 hp represents an industry consensus on the appropriate cutpoint for this purpose. We invite comment on the 75 hp cutpoint.

We are therefore proposing to regroup power ratings using the 75 hp cutpoint. Some have expressed that this may somewhat complicate the transition from tier to tier and efforts to harmonize with the European Union’s nonroad diesel program (which currently uses power cutpoints corresponding to 50 and 100 hp). However, we believe that it provides substantial long-term benefits for the environment (for example, by linking NOx standard-setting to an

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[122] The Tier 1 / 2 / 3 programs make use of 9 categories divided by horsepower: <11, 11-25, 25-50, 50-100, 100-175, 175-300, 300-600, 600-750, and >750 hp.

engine technology-based 75 hp cutpoint). We will continue working with key entities to advance harmonization as this rule is developed.

We are also proposing to consolidate some power categories that were created in the past to allow for variations in standards levels and timing appropriate for Tiers 1, 2 and 3, and that remain in effect for those tiers, but which under this proposal are no longer distinct from each other with respect to standards levels and timing. These consolidations are: (1) the less than 11 hp and 11-25 hp categories into a single category of less than 25 hp, (2) the 75-100 hp portion of the 50-100 hp category and the 100-175 hp category into a single category of 75-175 hp, and (3) the 175-300 hp, 300-600 hp, and 600-750 hp categories into a single category of 175-750 hp. The result is the 5 power bands shown in Figures III.B-1 and 2 instead of the former 9. This will also help to facilitate use of equipment manufacturer transition flexibility allowances which can be applied only within each power band, as discussed in Section VII.B. We ask for comment on this regrouping, especially with regard to the appropriate power cutpoint for the engine families that are similar to highway engine families. Again, most useful in this regard would be information showing how highway and nonroad engines in this range do or do not share common design bases.

d. PM Standards for Smaller Engines

i. <25 hp

We believe that standards based on the use of PM filters should not be proposed at this time for the very small diesel engines below 25 hp. Although this technology could be adapted to these engines, the cost of doing so with known technology could be unacceptably high, relative to the cost of producing the engines themselves. Based on past experience, we expect that advancements in reducing these costs will occur over time. We plan to reassess the appropriate long-term standards in a technology review as discussed in Section III.G. For the nearer-term, we believe that other proven PM-reducing technologies such as diesel oxidation catalysts and engine optimization can be applied to engines under 25 hp for very cost-efficient PM control, as discussed in Sections III.E and V.A. When implemented, the PM standard proposed in Figure III.B-1 for these engines, along with the proposed transient test cycle, will yield an in-use PM reduction of over 50% for these engines, and large reductions in toxic hydrocarbons as well. Achieving these emission reductions is very important, considering the fact that many of these smaller engines operate in populated areas and in equipment without closed cabs-- in mowers, portable electric power generators, small skid steer loaders, and the like. We invite comment on this proposed approach to controlling harmful emissions from very small nonroad diesel engines.

It is our assessment that achieving low PM emission levels is especially challenging for one subclass of small engines: the air-cooled, direct injection engines under 11 hp that are startable by hand, such as with a crank or recoil starter. These typically one-cylinder engines find utility in applications such as plate compactors, where compactness and simplicity are needed, but where the ruggedness typical of a diesel engine is also essential. There are a number of considerations in the design, manufacture, and marketing of these engines that combine to make them difficult to optimize for low emissions. These include the air-cooled engine's need for relatively loose design fit tolerances to accommodate thermal expansion variability (which can lead to increased soluble organic PM), small cylinder displacement and bore sizes that limit use of some combustion chamber design strategies and increase the propensity for PM-producing fuel impingement on cylinder walls, the difficulty in obtaining components for small engines with machining tolerances tight enough to yield consistent emissions performance, and cost reduction pressures caused by competition from cheaper gasoline engines in some of the same applications.

As a result, we are proposing an alternative compliance option that allows manufacturers of these engines to delay Tier 4 compliance until 2010, and in that year to certify them to a PM standard of 0.45 g/hp-hr, rather than to the 0.30 g/hp-hr PM standard applicable to the other engines in this power category beginning in 2008. Engines certified under this alternative compliance requirement would not be allowed to generate credits as part of the ABT program, although credit use by these engines would still be allowed. We believe that this ABT restriction is important to avoid potential abuse of this option, and is a reasonable means of dealing with the concern as it would apply only to those air-cooled, hand-startable, direct injection engines under 11 hp that are certified under this special compliance option, and the production of credit-generating engines would be contrary to the option's purpose. Furthermore, because the proposed 2010 Tier 4 implementation year for these engines is the same year that 15 ppm sulfur nonroad diesel fuel would become available, we are also proposing that certification testing and any subsequent compliance testing on engines certified under this option may be conducted using the 7-15 ppm sulfur test fuel discussed in Section VII.H. Although this is one year earlier than would be otherwise allowable, we believe it would have a minimal impact on the proposed program's environmental benefit considering the extremely small contribution these engines make to emissions inventories, and the fact that these engines would generally operate in the field on higher sulfur fuels for at most a few months.

ii. 25-75 hp

We believe that the proposed 0.22 g/bhp-hr PM standard for 25-75 hp engines in 2008 is warranted because the Tier 2 PM standards that take effect in 2004 for these engines, 0.45 and 0.30 g/bhp-hr for 25-50 and 50-75 hp engines, respectively, do not represent the maximum achievable reduction using technology which will be available by 2008. However, as discussed in Section III.B.1.a, filter-based technology for these engines is not expected to be available on a widespread basis until the 2013 model year. The proposed 2008 PM standard for these engines should maximize reduction of PM emissions based on technology available in that year. We believe that the 2008 standards are feasible for these engines, based on the same engine or oxidation catalyst technologies feasible for engines under 25 hp in 2008, following the proposed introduction of nonroad diesel fuel with sulfur levels reduced below 500 ppm. We expect in-use PM reductions for these engines of over 50%, and large reductions in toxic hydrocarbons as well over the five model years this standard would be in effect (2008-2012). These engines will constitute a large portion of the in-use population of nonroad diesel engines for many years after 2008.

We request comment on our proposal to implement Tier 4 PM standards for 25-75 hp engines in the two phases just noted: a non-PM filter based standard in 2008 and a filter-based standard in 2013. In addition, we request comment on whether it would be better not to set a Tier 4 PM standard in 2008 so that engine designers could instead focus their efforts on meeting a PM-filter based standard for these engines earlier, say in 2012. (It should be noted that the proposed rule would provide this as an option for a subgroup of these engines (50-75 hp). See Figure III.B-1 note b.) We would assume that under this approach the proposed new NOx+NMHC standard for 25-50 hp engines in this category would also start in 2012, to avoid requiring two design changes in two years. Any comments in support of this approach should, if possible, include information to support a conclusion that the earlier start date for a PM filter-based standard would be technologically feasible.

We believe that the proposed 2008 PM standards for engines under 75 hp can be met either through engine optimization, by the use of diesel oxidation catalysts, or by some combination thereof, as discussed in Section III.E. For engines that comply through the use of oxidation catalysts, NMHC emissions are expected to be very low because properly designed oxidation catalysts are effective at oxidizing gaseous hydrocarbons as well as the soluble organic fraction of diesel exhaust PM . Engines complying with the proposed 2008 PM standard without the use of oxidation catalysts would, on the other hand, be expected to emit NMHC at about the same levels as Tier 2 engines. Recognizing that NMHC emissions from diesel engines can include a number of toxic compounds, and that there are many of these small diesel engines operating in populated areas, we are interested in comment on the appropriateness of setting a more stringent NMHC standard for these engines in 2008 to better control these emissions. We expect that doing so would likely result in more widespread use of oxidation catalysts (rather than engine optimization) for these engines. We would not, however, expect this to lead to a more stringent PM standard than the one we are proposing, based on the feasibility discussion in Section III.E.

e. Engines Above 750 hp

For engines above 750 hp, additional lead time to fully implement Tier 4 is warranted due to the relatively long product design cycles typical of these high-cost, low-sales volume engines and machines. The long product design cycle issue is the primary reason we did not set Tier 3 standards for these engines in the 1998 rule and are not proposing to do so now. Instead, we are proposing that these engines move from the Tier 2 standards, which take effect in 2006, to Tier 4 standards beginning in 2011, five years later. Moreover, we are proposing that the Tier 4 PM standard be phased in for these engines on the same 50-50-50-100% schedule as the NOx and NMHC phase-in schedule, rather than all at once in 2011 as for engines between 175 and 750 hp. (See Figure III.B-1.) This would provide engine manufacturers with up to 8 years of design stability to address concerns associated with product design cycles and low sales volumes typical of this category. The engine manufacturer ABT program adds additional flexibility. Even longer stability periods could exist for equipment manufacturers using these engines because they have their own transition flexibility provisions available on top of the engine standard phase-in. This is especially significant because many of these large machines are built by manufacturers who build their own engines, or who work closely with their engine suppliers, and can thus create a long-term product plan making coordinated use of engine and equipment flexibility provisions.

We think that, taken together, these provisions appropriately balance the need for expeditious emission reductions with issues relating to lead time, technology development, and cost for these engines and machines. Even so, some engine and equipment manufacturers have expressed concerns to us that, though not challenging the Tier 4 program endpoint (high-efficiency PM and NOx exhaust emission controls), in their estimation our proposed program implementation provisions do not adequately address their timing concerns. In particular, they have expressed a view that they need until 2012 (one additional year) before they could begin to phase in Tier 4 standards for this category. They have also expressed the view that mobile machinery such as mine haul trucks and dozers (as differentiated from equipment such as nonroad diesel generators that also use engines in this hp range) present unique challenges that could require more time to resolve than would be afforded by the proposed 2014 phase-in completion date.

Although we believe that the implementation schedule and flexibility provisions we are proposing will enable the manufacturers to meet these challenges, we acknowledge the manufacturers' concerns and ask for comment on this issue. Specifically, we request comment on whether this category, or some subset of it defined by hp or application, should have a later phase-in start date, a later phase-in end date, adjusted standards, additional equipment manufacturer flexibility provisions, or some combination of these. Technical information backing the commenter's view would be most helpful in this regard.

As with the NOx/NMHC phase-in for all engines at or above 75 hp, we are proposing that the PM phase-in for engines above 750 hp would have to be met on the same engines as the Tier 4 NOx and NMHC standards during the phase-in years. That is, engines certified to the Tier 4 NOx and NMHC requirements would be expected to certify to the Tier 4 PM standard as well.

f. CO Standards

We are proposing minor changes in CO standards for some engines solely for the purpose of helping to consolidate power categories. These amount to a change for engines under 11 hp from 6.0 to 4.9 g/bhp-hr in 2008 to match the existing Tier 2 CO standard for 11-25 hp engines, and a change for engines at or above 25 hp but below 50 hp from 4.1 to 3.7 g/bhp-hr to match the existing Tier 3 CO standard for 50-75 hp engines, also in 2008. These minor proposed changes are not expected to add a notable compliance burden. Nevertheless, we expect that the use of high-efficiency exhaust emission controls will yield a substantial reduction in CO emissions, as discussed in Chapter 4 of the draft RIA.

These minor adjustments to the CO standard are based solely on our desire to simplify the administrative process for the engine manufacturers which arises from the reduction in the number of the engine power categories we have proposed for Tier 4. We are not exercising our authority to revise the CO standard for nonroad diesel engines for the purpose of improving air quality at this time, and therefore the minor adjustments we have proposed today, though feasible, are not based on a detailed evaluation of the capabilities of advanced exhaust aftertreatment technology to reduce CO levels.

g. Exclusion of Marine Engines

These proposed emission standards would apply to engines in the same applications covered by EPA's existing nonroad diesel engine standards, at 40 CFR part 89, except that they would not apply to marine diesel engines. Marine diesel engines below 50 hp were included in our 1998 rule that set nonroad diesel emission standards (63 FR 56968, October 23, 1998). In that rule, we expected that the engine modifications needed to achieve those standards (e.g., in-cylinder controls) for marine engines would not need to be different from those for land-based engines of this size.

The standards for diesel engines below 50 hp being proposed in this action are likely to require PM filters or diesel oxidation catalysts on many or all engines, and transferring this technology to the marine diesel engines of any size raises unique issues. For example, many marine diesel engines have water-jacketed exhaust which may result in different exhaust temperatures and which could affect aftertreatment efficiency. The modified marine engine designs would also have to meet Coast Guard requirements. These and other conditions may require separate design efforts for marine diesel engines. Therefore, we believe it is more appropriate to consider more stringent standards for marine diesel engines below 50 hp in a future action. It should be noted, however, that the existing Tier 2 standards will continue to apply to marine diesel engines under 50 hp until that future action is completed.

2. Crankcase Emissions Control

Crankcase emissions are the pollutants that are emitted in the gases that are vented from an engine's crankcase. These gases are also referred to as "blowby gases" because they result from engine exhaust from the combustion chamber "blowing by" the piston rings into the crankcase. These gases are often vented to prevent high pressures from occurring in the crankcase. Our existing emission standards require control of crankcase emissions from all nonroad diesel engines except turbocharged engines. The most common way to eliminate crankcase emissions has been to vent the blowby gases into the engine air intake system, so that the gases can be recombusted. Following the precedent we set for heavy-duty highway diesel engines in an earlier rulemaking, we made the exception for turbocharged nonroad diesel engines because of concerns about fouling that could occur by routing the diesel particulates (including engine oil) into the turbocharger and aftercooler. Our concerns are now alleviated by newly developed closed crankcase filtration systems, specifically designed for turbocharged diesel engines. These new systems are already required in parts of Europe for new highway diesel engines under the EURO III emission standards, and are expected to be used in meeting new U.S. EPA crankcase emission control standards for heavy-duty highway diesel engines beginning in 2007 (see Section III.C.1.c of the preamble to the 2007 heavy-duty highway final rule).

We are therefore proposing to eliminate the exception for turbocharged nonroad diesel engines starting in the same model year that Tier 4 exhaust emission standards first apply in each power category. This is 2008 for engines below 75 hp, except for 50-75 hp engines for which a manufacturer opts to skip the 2008 PM standard. The crankcase requirement applies to "phase-in" engines above 750 hp under the 50% phase-in requirement for 2011-2013, but not to the "phase-out" engines in that power category during those years. This is an environmentally significant proposal since many nonroad machine models use turbocharged engines, and a single engine can emit over 100 pounds of NOx, NMHC, and PM from the crankcase over the lifetime of the engine. We also note that the cost of control is small (see Section V).

Our existing regulatory requirement for controlling crankcase emissions from naturally-aspirated nonroad engines allows manufacturers to route the crankcase gases into the exhaust stream instead of the engine air intake system, provided they keep the combined total of the crankcase emissions and the exhaust emissions below the applicable exhaust emission standards. We are proposing to extend this allowance to the turbocharged engines as well. We are also proposing to give manufacturers the option to measure crankcase emissions instead of completely eliminating them, and adding the measured emissions to exhaust emissions in assessing compliance with exhaust emissions standards. This allowance was adopted for highway HDDEs in 2001 (see Section VI.A.3 of the preamble to the 2007 heavy-duty highway final rule). As in the highway program, manufacturers choosing to use this allowance rather than to seal the crankcase would need to modify their exhaust deterioration factors or to develop separate deterioration factors to account for increases in crankcase emissions as the engine ages. Manufacturers would also be responsible for ensuring that crankcase emissions would be readily measurable in use.

C. What Test Procedure Changes Are Being Proposed?

We are proposing a number of changes to the certification test procedures by which compliance with emission standards is determined. Two of these are particularly significant: The addition of a supplemental transient emissions test and the addition of a cold start testing component to the proposed transient emissions test. These are discussed briefly in this section, and in more detail in section VII.F. Other proposed changes are also discussed in section VII.F and deal with:

- Adoption of an improved smoke testing procedure, with associated standards levels and exemptions.
- Addition of a steady-state test cycle for transportation refrigeration units.
- Test procedure changes intended to improve testing precision, especially with regards to sampling methods.
- A clarification to existing EPA defeat device regulations.

1. Supplemental Transient Test

In the 1998 final rule that set new emission standards for nonroad diesel engines, we expressed a concern that the steady-state test cycles used to demonstrate compliance with emission standards did not adequately reflect transient operation, and, because most nonroad engines are used in applications that are largely transient in nature, would therefore not yield adequate control in use (63 FR 56984, October 23, 1998). Although we were not prepared to adopt a transient test at that time, we announced our intention in that final rule to move forward with the development of such a test. This development has progressed steadily since that time, and has resulted in the creation of a Nonroad Transient Composite (NRTC) test cycle, which we are now proposing to adopt in our nonroad diesel program, to supplement the existing steady-state tests. We expect that this proposed requirement will significantly reduce real world emissions from nonroad diesel equipment. Instead of sampling engine operation at the few isolated operating points of steady-state emission tests, proper transient testing can capture emissions from the broad range of engine speed and load combinations that the engine may attain in use, as well as emissions resulting from the change in speed or load itself, such as those induced by turbocharger lag.

The proposed NRTC cycle will capture transient emissions over much of the typical nonroad engine operating range, and thus help ensure effective control of all regulated pollutants. In keeping with our goal to maximize the harmonization of emissions control programs as much as possible, we have developed this cycle in collaboration with nonroad engine manufacturers and regulatory bodies in the United States, Europe, and Japan over the last several years.[123] Further, the NRTC cycle has been introduced as a work item for possible adoption as a potential global technical regulation under the 1998 Agreement for Working Party 29 at the United Nations.[124]

The Agency is proposing that emission standards be met on both the current steady-state duty cycles and the new transient duty cycles. The transient testing would begin in the model year that the trap-based Tier 4 PM standards and/or adsorber-based Tier 4 NOx standards first apply. This would be 2011 for engines at or above 175 hp, 2012 for 75-175 hp engines (2012 for 50-75 hp engines made by a manufacturer choosing the optional approach described in footnote b of Figure III.B-1), and 2013 for engines under 75 hp. See also Table VII.F.-1. In addition, any engines for which a manufacturer claims credit under the incentive program for early-introduction engines (see section VII.E) would have to be certified to that program's standards under the NRTC cycle and, in turn, the 2011 or later model year engines that use these engine count-based credits would not need to demonstrate compliance under the NRTC cycle.

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[123] Letter from Jed Mandel of the Engine Manufacturers Association to Chet France of US EPA, Office of Transportation and Air Quality, Docket A-2001-28.

[124] Informal Document No.2, ISO - 45th GRPE, "Proposal for a Charter for the Working Group on a New Test Protocol for Exhaust Emissions from Nonroad Mobile Machinery", 13-17 January 2003, Docket A-2001-28.

Although we intend that transient emissions control be an integral part of Tier 4 design considerations, we do not believe it appropriate to mandate compliance with the transient test for the engines under 75 hp subject to proposed PM standards in 2008. We recognize that transient emissions testing, though routine in highway engine programs, involves a fair amount of new laboratory equipment and expertise in the nonroad engine certification process. As with the transfer of advanced emission control technology itself, we believe that the transient test requirement should be implemented first for larger engines more likely to be made by engine manufacturers who also have highway engine markets. We do not believe that the smaller engines should be the lead power categories in implementing the new transient test, especially because many manufacturers of these engines do not make highway engines and are not as experienced or well-equipped as their large-engine counterparts for conducting transient cycle testing.

Engines below 25 hp involve an additional consideration for timing of the transient test requirement because we are not proposing PM-filter based standards for them. We propose that testing on the NRTC cycle not be required for these engines until the 2013 model year, the last year in which engines in higher power categories are required to use this test. We are concerned that manufacturers not view this proposed deferral of the transient test requirement as a structured second level of required control for these engines. To address this concern and because we wish to encourage the demonstration of transient emission control as early as possible, we are proposing to allow manufacturers to optionally certify engines below 25 hp under the NRTC cycle beginning in the 2008 model year, and to extend this option to 25-75 hp engines subject to engines meeting the transitional PM standard in 2008. (See also the discussion in section VII.F.1 on this issue.) We request comment on this proposed approach and on whether it would be better to deal with this concern by requiring compliance under the transient test when the Tier 4 standards begin in 2008.

In applying the NRTC test requirement coincident with the start of PM filter-based standards, we do not mean to imply that control of PM from filter-equipped engines is the only or even the primary concern being addressed by transient testing. In fact, we believe that advanced NOx emission controls may be more sensitive to transient operation than PM filters. It is, however, our intent that the control of emissions during transient operation be an integral part of Tier 4 engine design considerations, and we therefore have proposed that transient testing be applied with the PM filter-based Tier 4 PM standards, because these standards precede or accompany the earliest Tier 4 NOx or NMHC standards in every power category. Even so, we request comment on whether the "phase-out" engines above 75 hp (those engines for which compliance with the Tier 4 NOx standard is not required during the phase-in period) should be exempted from the requirement to meet the applicable NMHC+NOx standard using the transient test. Although our interest in ensuring transient emissions control as quickly as possible in the Tier 4 program, and in avoiding test program complexity, would argue against this approach, we are also interested in not diverting engine designers from the challenging task of redesigning engines to meet the proposed 0.30 g/bhp-hr Tier 4 NOx standard before and during the phase-in years by having to deal with transient control under an NMHC+NOx standard that is being phased out.

We are in fact not proposing to apply the transient test to phase-out engines above 750 hp that are carried over from pre-2011 Tier 2 engine designs. Unlike phase-out engines at or below 750 hp, these engines are not subject to a Tier 4 PM standard in 2011. They would thus be Tier 2 engine designs and we do not believe that subjecting them to transient testing would be appropriate. On the other hand, engines in any power category certified to an average NOx standard under the "split family" provision described in section VII.A would all be subject to the transient test requirement, as they would clearly have to be substantially redesigned to achieve Tier 4 compliance, regardless of whether or not they use high-efficiency exhaust emission controls.

The Agency is proposing that engine manufacturers may certify constant-speed engines using EPA's Constant Speed Variable Load (CSVL) transient duty cycle[125] as an alternative to testing these engines under the NRTC provisions. The CSVL transient cycle more closely matches the speed and load operating characteristics of many constant-speed nonroad diesel applications than EPA's proposed NRTC cycle.[126] However, the manufacturer would be obligated to ensure that such engines would be used only in constant-speed applications. A more detailed discussion of the proposed NRTC and CSVL supplemental transient test cycles and associated provisions is contained in Section VII.F of this preamble and in Chapter 4 of the Draft RIA.

2. Cold Start Testing

In the field, the typical nonroad diesel machine will be started and will warm to a point of heat-stable operation at least once a workday. Such "cold start" conditions may also occur at other times over the course of the workday, after a lunch break for example. During these periods of cold start operation, the engine may be emitting at a higher rate than when the engine is running efficiently at its stabilized operating temperature. This may be especially the case for emission control designs employing catalytic devices in the exhaust system, which require heating to a "light-off" temperature to begin working. EPA's highway engine and vehicle programs, which have resulted in increasingly widespread use of such catalytic devices, have recognized and dealt with this concern for several years, typically by repeating transient tests in both the "cold" and "hot" conditions, and weighting emission results in some fashion to create a combined result for evaluation against emission standards.

We believe that our proposed move to supplemental transient testing, combined with our proposed Tier 4 standards that will bring about the use of catalytic devices in nonroad diesel engines, makes it imperative that we also propose to include such a cold start test as part of the

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[125] Memoranda from Kent Helmer to Cleophas Jackson, "Speed and Load Operating Schedule for the Constant Speed Variable Load (CSVL) transient test cycle" and "CSVL Cycle Construction"; and Southwest Research Institute - Final Report , all in Docket A-2001-28, .

[126] Memorandum from Kent Helmer to Cleophas Jackson, "Brake-specific Emissions Impact of Nonroad Diesel Engine Testing Over the NRTC, AWQ, and AW1 duty cycles", Docket A-2001-28 .

transient test procedure requirement. We propose to weight the cold start emission test results as one-tenth of the total with hot-start emissions accounting for the other nine-tenths. The one-tenth weighting factor is derived from a review of the present nonroad equipment population. For more detailed information on this proposal, refer to section VII.F of this preamble and Chapter 4 of the Draft RIA. EPA requests comment on this approach to ensuring control of cold start emissions.

D. What is Being Done to Help Ensure Robust Control In Use?

EPA's goal is to ensure real-world emissions control over the broad range of in-use operation that can occur, rather than just controlling emissions over prescribed test cycles executed under restricted laboratory conditions. An important tool for achieving this in-use emissions control is the setting of Not-To-Exceed (NTE) emission standards, which, in this notice, the Agency is proposing to adopt for new nonroad engines. EPA is also considering two additional means of in-use emissions control that will be proposed in separate notices. These are 1) a manufacturer-run in-use emissions test program and 2) on-board diagnostics (OBD) requirements for new nonroad diesel engines. When implemented, all three of these will help assure that in-use emissions control is achieved.

1. Not-to-Exceed Requirements

EPA proposes to adopt not-to-exceed (NTE) emission standards for all new nonroad diesel engines subject to the Tier 4 emissions standards beginning in 2011 proposed in Section III. B. of this proposal. EPA already has similar NTE standards set for highway heavy-duty diesel engines, compression ignition marine engines, and nonroad spark-ignition engines.

To help ensure that nonroad diesel emissions are controlled over the wide range of speed and load combinations commonly experienced in-use, EPA is proposing to apply NTE limits and related test procedures. The NTE approach establishes an area (the "NTE zone") under the torque curve of an engine where emissions must not exceed a specified value for any of the regulated pollutants. The NTE standard would apply under any conditions that could reasonably be expected to be seen by that engine in normal vehicle operation and use, within certain broad ranges of real ambient conditions. The NTE requirements would help to ensure emission benefits over the full range of in-use operating conditions. EPA believes that basing the emissions standards on a set of distinct steady state and transient cycles and using the NTE zone to help ensure in-use control creates a comprehensive program. In addition, the NTE requirements would also be an effective element of an in-use testing program. The test procedure is very flexible so it can represent most in-use operation and ambient conditions. Therefore, the NTE approach takes all of the benefits of a numerical standard and test procedure and expands it to cover a broad range of conditions. Also, with the NTE approach, in-use testing and compliance become much easier since emissions may be sampled during normal vehicle use. A standard that relies on laboratory testing over a very specific driving schedule makes it harder to perform in-use testing, especially for engines, since the engines would have to be removed from the vehicle. Testing during normal vehicle use, using an objective numerical standard, makes enforcement easier and provides more certainty of what is occurring in use versus a fixed laboratory procedure.

In today's notice, we are proposing an NTE standard which is based on the approach taken for the 2007 highway heavy-duty diesel engines. In addition, we are requesting comment on an alternative NTE standard approach which, while different from the highway NTE standard approach, is designed to achieve the same environmental objectives. Both of these approaches are described below.

a. NTE Standards We are Proposing

The Agency proposes to adopt for new Tier 4 non-road diesel engines similar NTE specifications as those finalized as part of the heavy-duty highway diesel engine rulemaking (See 66 Fed. Reg. 5001 January 18, 2001). These specifications for the highway diesel engines are contained in 40 CFR Part 86.007-11 and 40 CFR Part 86.1370-2007.

Our NTE proposal for nonroad contains the same basic provisions as the highway NTE. The proposed nonroad NTE standard establishes an area (the "NTE control area") under the torque curve of an engine where emissions must not exceed a specified value for any of the regulated pollutants.[127] This NTE control area is defined in the same manner as the highway NTE control areas, and is therefore a subset of the engine's possible speed and load operating range. The NTE standard would apply under any engine operating conditions that could reasonably be expected to be seen by that engine in normal vehicle/equipment operation and use which occurs within the NTE control zone and which also occurs during the wide range of real ambient conditions specified for the NTE. The NTE standard applies to emissions sampled during a time duration as small as 30 seconds. The NTE standard requirements for nonroad diesel engines are summarized below and specified in the proposed regulations at 40 CFR 1309.101 and 40 CFR 1039.515. These requirements would take effect as early as 2011, as shown in shown in Table III.D-1. The NTE standard would apply to engines at the time of certification as well as in use throughout the useful life of the engine.

[127] Torque is a measure of rotational force. The torque curve for an engine is determined by an engine "mapping" procedure specified in the Code of Federal Regulations. The intent of the mapping procedure is to determine the maximum available torque at all engine speeds. The torque curve is merely a graphical representation of the maximum torque across all engine speeds.

TABLE III.D-1 -- NTE STANDARD IMPLEMENTATION SCHEDULE

Power Category	NTE Implementation Model Year[a]
<25 hp	2013
25-75 hp	2013[b]
75-175 hp	2012
175-750 hp	2011
>750 hp	2011[c]

Notes:
[a] The NTE applies for each power category once Tier 4 standards were implemented, such that all engines in a given power category are required to meet NTE standards.
[b] The NTE standard would apply in 2012 for any engines in the 50-75 hp range who choose not to comply with the proposed 2008 transitional PM standard
[c] The NTE standard only applies to the 50 percent of the engines in the >750 hp category which are complying with the proposed Tier 4 standard. Beginning in 2014 the NTE standard would apply to all nonroad engines >750 hp when the remaining 50 percent of the engines must comply with the Tier 4 standard.

The NTE test procedure can be run in nonroad equipment during field operation or in an emissions testing laboratory using an appropriate dynamometer. The test itself does not involve a specific operating cycle of any specific length, rather it involves nonroad equipment operation of any type which could reasonably be expected to occur in normal nonroad equipment operation that could occur within the bounds of the NTE control area. The nonroad equipment (or engine) is operated under conditions that may reasonably be expected to be encountered in normal vehicle operation and use, including operation under steady-state or transient conditions and under varying ambient conditions. Emissions are averaged over a minimum time of thirty seconds and then compared to the applicable emission standard. The NTE standard applies over a wide range of ambient conditions, including up to an altitude of 5,500 feet above-sea level at ambient temperatures as high as 86 deg. F, and at sea-level up to ambient temperatures as high as 100 deg. F. The specific temperature and altitude conditions under which the NTE applies, as well as the proposed methodology for correcting emissions results for temperature and/or humidity are specified in the proposed regulations.

In addition, as with the 2007 highway NTE standard, we are proposing a transition period during which a manufacturer could apply for an NTE deficiency for a nonroad diesel engine family. The NTE deficiency provisions would allow the Administrator to accept a nonroad diesel engine as compliant with the NTE standards even though some specific requirements are not fully met. We are proposing these NTE deficiency provisions because we believe that, despite the best efforts of manufacturers, for the first few model years it is possible some manufacturers may have technical problems that are limited in nature but can not be remedied in time to meet production schedules. We are not limiting the number of NTE deficiencies a manufacturer can apply for during the first 3 model years for which the NTE applies. For the fourth through the seventh model year after which the NTE standards are implemented, a manufacturer could apply for no more than three NTE deficiencies per engine family. No deficiency may be applied for or granted after the seventh model year. The NTE deficiency provision will only be considered for failures to meet the NTE requirements. EPA will not consider an application for a deficiency for failure to meet the FTP or supplemental transient standards.

The NTE standards we are proposing are a function of FTP emission standards contained in this proposal and described in Section III.B. As with the NTE standards we have established for the 2007 highway rule, we are proposing an NTE standard which is determined as a multiple of the engine families underlying FTP emission standard. In addition, as with the 2007 highway standard, the multiple is either 1.25 or 1.5, depending on the value of the FTP standard (or the engine families FEL). These multipliers are based on EPA's assessment of the technological feasibility of the NTE standard, and our assessment that as the underlying FTP standard becomes more stringent, the NTE multiplier should increase (from 1.25 to 1.5). The proposed standard or FEL thresholds for the 1.25x multiplier and the 1.5x multiplier are specified for each regulated emission in Table III.D-2.

TABLE III.D-2 -- THRESHOLDS FOR APPLYING NTE STANDARD OF 1.25XFTP STANDARD VS. 1.5X FTP STANDARD

Emission	Apply 1.25x NTE when...	Apply 1.5x when...
NOx	NOx std or FEL≥ 1.5 g/bhp-hr	NOx std or FEL< 1.5 g/bhp-hr
NMHC	NOx std or FEL≥ 1.5 g/bhp-hr	NOx std or FEL< 1.5 g/bhp-hr
NOx+NMHC	NMHC+NOx std or FEL≥ 1.6 g/bhp-hr	NMHC+NOx std or FEL< 1.6 g/bhp-hr
PM	PM std or FEL≥0.05 g/bhp-hr	PM std or FEL< 0.05 g/bhp-hr
CO	All stds or FELs	No stds or FELs

For example, beginning in 2011, the proposed NTE standard for engines meeting a FTP PM standard of 0.01 g/bhp-hr and a FTP NOx standard of 0.30 g/bhp-hr would be 0.02 g/bhp-hr PM and 0.45 g/bhp-hr NOx.

In addition, the nonroad NTE proposal specifies a number of additional engine operating conditions which are not subject to the NTE standard. Specifically: the NTE does not apply during engine start-up conditions; the NTE does not apply during very cold engine intake conditions defined in the proposed regulations for EGR equipped engines during which the engine may require an engine protection strategy; and, finally, for engines equipped with an exhaust emission control device (such as a CDPF or a NOx adsorber), the NTE does not apply during warm-up conditions for the exhaust emission control device, specifically the NTE does not apply with the exhaust gas temperature on the outlet side of the exhaust emission control device is less than 250 degrees Celsius.

b. Comment Request on an Alternative NTE Approach

In addition the Agency requests comment on the following set of NTE specifications as an alternative to those NTE provisions proposed. This alternative NTE would use the same numeric standard values as under the proposed NTE standards discussed in Section III.D.1a, however, the test procedure itself is quite different, as described below. The Agency believes that these alternative specifications and the range of operation covered by the standard would provide for similar, if not more robust nonroad engine compliance compared to the application of the proposed NTE specifications to nonroad engines. These alternative provisions have been developed to emphasize compliance over all engine operation, including engine operation that would not be covered under the proposed NTE approach. In addition these specifications were developed specifically to simplify on-vehicle testing for NTE compliance. The NTE control area would include all engine operation. The averaging intervals over which NTE standards must be met are different than the 30-second minimum set in the proposal. They are variable in time but are constant as a function of work. Emissions would be measured over a constant averaging work interval, determined as ten percent (10%) of the total work performed by the engine over a specified period of time (e.g., a minimum of six hours of operation). This 10% window of work "moves" through data at one percent (1%) increments so as to always return about ninety (90) individual data points for direct comparison to the NTE standards.

Comments should address the potential exclusive use of these alternative provisions for nonroad diesel engine NTE compliance. For more detailed information on these alternative NTE provisions, refer to Preamble Section VIIG "Not-to-Exceed Requirements" and Chapter 4 of the draft RIA of this proposal.

2. Plans for a Future In-Use Testing and Onboard Diagnostics

In addition to the proposals in this notice, EPA is currently reviewing several related regulatory provisions concerning control of emissions from nonroad diesel engines. They are not included in this proposal, as EPA believes these aspects of an effective emission control program would benefit from further evaluation and development prior to their proposal. EPA intends to explore these provisions further in the coming months and publish a separate notice of proposed rulemaking dealing with these issues. In particular, there are two issues which will be discussed: 1) a manufacturer-run in-use emissions testing program; and 2) OBD requirements for nonroad diesel engines. The Agency believes that it is appropriate to proceed with the current rulemaking, expecting that these two issues will be proposed in the near future. EPA expects these programs would be adopted in advance of the effective date of the engine emissions standards. This will allow us to gather information and work with interested parties in a separate process regarding these issues. EPA will work with all parties involved, including states, environmental organizations and manufacturers, to develop robust, creative, environmentally protective and cost-effective proposals addressing these issues.

a. Plans for a Future Manufacturer-Run In-Use Test Program

It is critical that nonroad diesel engines meet the applicable emission standards throughout their useful lives, to sustain those emission benefits over the broadest range of in-use operating conditions. The Agency believes that a manufacturer-run in-use testing program that is designed to generate data on in-use emissions of nonroad diesel engines can be used by EPA and the engine manufacturers to ensure that emissions standards are met throughout the useful life of the engines, under conditions normally experienced in-use. An effective program can be designed to monitor for NTE compliance and to help ensure overall compliance with emission standards.

The Agency expects to pattern the manufacturer-run in-use testing requirements for nonroad diesel engines after a program that is being developed for heavy-duty highway vehicles. In this latter program, EPA is committed to incorporating a two-year pilot program. The pilot program will allow the Agency and manufacturers to gain the necessary experience with the in-use testing protocols and generation of in-use test data using portable emission measurement devices prior to fully implementing program. A similar pilot program is expected to be part of any manufacturer-run in-use NTE test program for nonroad engines.

The Agency plans to promulgate the in-use testing requirements for heavy-duty highway vehicles in the December 2004 time frame. EPA anticipates proposing a manufacturer-run in-use testing program for nonroad diesel engines by 2005 or earlier. As mentioned above, the nonroad diesel engine program is expected to be patterned after the heavy-duty highway program.

b. Onboard Diagnostics

Today's notice does not propose to require onboard diagnostic (OBD) systems for non-road diesel vehicles and engines. However, EPA has committed to creating OBD requirements for heavy-duty highway engines/ vehicles over 14,000 lbs GVWR and will develop OBD requirements for nonoad in conjunction with or following the highway OBD development. The Agency will propose nonroad diesel OBD requirements, along with heavy-duty highway OBD requirements, because OBD is necessary for maintaining and ensuring compliance with emission standards over the lifetime of engines. We will gather further information and coordinate with the heavy-duty highway and nonroad diesel industry and other stakeholders to develop proposed OBD system requirements.

E. Are the Proposed New Standards Feasible?

Prior to 1990, diesel engines could be broadly grouped into two categories; indirect-injection (IDI) diesel engines that were relatively inexpensive while providing somewhat better fuel economy compared to gasoline engines, and direct-injection (DI) diesel engines that were substantially more expensive but which offered better fuel economy. The majority of diesel engines fell into the first category, especially in the case of passenger cars, smaller heavy-duty trucks and most nonroad engines below 200 horsepower.

Diesel engine technology has changed rapidly since the early 1990s with the widespread use of electronics, onboard computers and the rise to preeminence of turbocharged direct-injection diesel engines. While some IDI engines remain, especially in the low horsepower portion of the nonroad market, most new diesel engines (including higher horsepower nonroad diesel engines) are turbocharged and direct-injected. Today's diesel engine has significantly improved, compared to historic engines with regard to issues of most concern to the user including noise, vibration, visible smoke emissions, startability, and performance. At the same time environmental benefits have also been realized with lower NOx emissions, lower PM emissions, and improving fuel economy. These changes have been most pronounced for smaller diesel engines applied in passenger cars and light-heavy trucks. Acceptance of the technology by the public, especially in Europe, has lead to a rapid increase in diesel use for smaller vehicles with diesel sales for passenger cars exceeding 50 percent in some countries.

At the end of the 1990s continuing concern regarding the serious risk to public health and welfare from diesel emissions and the emergence of new emission control technologies enabled by low sulfur fuels led policy makers to set new future diesel fuel specifications and to set challenging new diesel emission standards for highway vehicles. In the United States, the EPA has set stringent new diesel emission standards for heavy-duty highway engines which will go into effect in 2007. These new standards are predicated on the use of Catalyzed Diesel Particulate Filters (CDPFs) which when used with less than 15ppm sulfur diesel fuel can reduce PM emissions by well over 90%, and on the use of NOx adsorber catalyst technology which when used with less than 15 ppm diesel fuel can reduce NOx emissions by more than 90%. When these technologies are fully implemented, the resulting diesel engine emissions will be 98% lower than the levels common to these diesel engines before 1990.

EPA has been conducting an ongoing technology progress review to measure industry progress to develop and introduce the needed clean fuel and clean engine technologies by 2007. The first in what will be a series of reports was published by EPA in June of 2002.[128] In the report, we concluded that technology developments by industry were progressing rapidly and that the necessary catalyzed diesel particulate filter and NOx adsorber technologies would be available for use by 2007.

Nonroad diesel engines are fundamentally similar to highway diesel engines. As noted above in Section III.B, in many cases, virtually identical engines are certified and sold for use in highway vehicles and nonroad equipment. Thus, emission control technologies developed for diesel engines can in general be applied to both highway and nonroad engines giving appropriate considerations to unique aspects of each application.

Today, we are proposing to set stringent new standards for a broad category of nonroad diesel engines. At the same time we are proposing to dramatically lower the sulfur level in nonroad diesel fuel ultimately to 15 ppm. We believe these standards are feasible given the availability of the clean 15 ppm sulfur fuel and the rapid progress to develop the needed emission

[128] Highway Diesel Progress Review, United States Environmental Protection Agency, June 2002, EPA 420-R-02-016. Copy available in EPA Air Docket A-2001-28.

control technologies. We acknowledge that these standards will be challenging for industry to meet in part due to differences in operating conditions and duty cycles for nonroad diesel engines. Also, we recognize that transferring and effectively applying these technologies, which have largely been developed for highway engines, will require additional lead time. We have given consideration to these issues in determining the appropriate timing and emission levels for the standards proposed today.

The following sections will discuss how these technologies work, issues specific to the application of these technologies to new nonroad engines, and why we believe that the emission standards proposed here are feasible. A more in-depth discussion of these technologies can be found in the draft RIA associated with this proposal, in the final RIA for the HD2007 emission standards and in the recently completed 2002 Highway Diesel Progress Review.[129] The following discussion summarizes the more detailed discussion found in the Draft RIA.

1. Technologies to Control NOx and PM Emissions from Mobile Source Diesel Engines

Present mobile source rules control the emissions of non-methane hydrocarbons (NMHC), oxides of nitrogen (NOx), carbon monoxide (CO), air toxics and particulate matter (PM) from diesel engines. Of these, PM and NOx emissions are typically the most difficult to control. CO and NMHC emissions are inherently low from diesel engines and under most conditions can be controlled to low levels without difficulty. NMHC emissions also serve as a proxy for some of the air toxic emissions from these engines, since many air toxics are a component of NMHC and are typically reduced in proportion to NMHC reductions. Most diesel engine emission control technologies are designed to reduce PM and NOx emissions without increasing CO and NMHC emissions above the already low diesel levels. Technologies to control PM and NOx emissions are described below separately. We also discuss the potential for these technologies to decrease CO and NMHC emissions as well as their potential to reduce emissions of air toxics.

a. PM Control Technologies

Particulate matter from diesel engines is made of three components;
- solid carbon soot,
- volatile and semi-volatile organic matter, and
- sulfate.

The formation of the solid carbon soot portion of PM is inherent in diesel engines due to the heterogenous distribution of fuel and air in a diesel combustion system. Diesel combustion is designed to allow for overall lean (excess oxygen) combustion giving good efficiencies and low CO and HC emissions with a small region of rich (excess fuel) combustion within the fuel injection plume. It is within this excess fuel region of the combustion that PM is formed when

129 Highway Diesel Progress Review, United States Environmental Protection Agency, June 2002, EPA 420-R-02-016. Copy available in EPA Air Docket A-2001-28.

high temperatures and a lack of oxygen cause the fuel to pyrolize, forming soot. Much of the soot formed in the engine is burned during the combustion process as the soot is mixed with oxygen in the cylinder at high temperatures. Any soot that is not fully burned before the exhaust valve is opened will be emitted form the engine as diesel PM.

The soot portion of PM emissions can be reduced by increasing the availability of oxygen within the cylinder for soot oxidation during combustion. Oxygen can be made more available by either increasing the oxygen content in-cylinder or by increasing the mixing of the fuel and oxygen in-cylinder. A number of technologies exist that can influence oxygen content and in-cylinder mixing including, improved fuel injection systems, air management systems, and combustion system designs.[130] Many of these PM reducing technologies offer better control of combustion in general, and better utilization of fuel allowing for improvements in fuel efficiency concurrent with reductions in PM emissions. Improvements in combustion technologies and refinements of these systems is an ongoing effort for highway engines and for some nonroad engines where emission standards or high fuel use encourage their introduction. The application of better combustion system technologies across the broad range of nonroad engines in order to meet the new emission standards proposed here offers an opportunity for significant reductions in engine-out PM emissions and possibly for reductions in fuel consumption. The soot portion of PM can be reduced further with aftertreatment technologies as discussed later in this section.

The volatile and semi-volatile organic material in diesel PM is often simply referred to as the soluble organic fraction (SOF) in reference to a test method used to measure its level. SOF is primarily composed of engine oil which passes through the engine with no or only partial oxidation and which condenses in the atmosphere to form PM. The SOF portion of diesel PM can be reduced through reductions in engine oil consumption and through oxidation of the SOF catalytically in the exhaust.

The sulfate portion of diesel PM is formed from sulfur present in diesel fuel and engine lubricating oil that oxidizes to form sulfuric acid (H_2SO_4) and then condenses in the atmosphere to form sulfate PM. Approximately two percent of the sulfur that enters a diesel engine from the fuel is emitted directly from the engine as sulfate PM.[131] The balance of the sulfur content is emitted from the engine as SO2. Oxidation catalyst technologies applied to control the SOF and soot portions of diesel PM can inadvertently oxidize SO2 in the exhaust to form sulfate PM. The

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130 The most effective means to reduce the soot portion of diesel PM engine-out is to operate the diesel engine with a homogenous method of operation rather than the typical heterogenous operation. In homogenous combustion, also called premixed combustion, the fuel is dispersed evenly with the air throughout the combustion system. This means there are no fuel rich / oxygen deprived regions of the system where fuel can be pyrolized rather than burned. Gasoline engines are typically premixed combustion engines. Homogenous combustion is possible with a diesel engine under certain circumstances, and is used in limited portions of engine operation by some engine manufacturers. Unfortunately, homogenous diesel combustion is not possible for most operation in today's diesel engine. We believe that more manufacturers will utilize this means to control diesel emissions within the limitations of the technology. A more in-depth discussion of homogenous diesel combustion can be found in the draft RIA.

131 Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition, EPA420-P-02-016, NR-009B. Copy available in EPA Air Docket A-2001-28.

oxidation of SO2 by oxidation catalysts to form sulfate PM is often called sulfate make. Without low sulfur diesel fuel, oxidation catalyst technology to control diesel PM is limited by the formation of sulfate PM in the exhaust as discussed in more detail in Section III.F below.

There are two common forms of exhaust aftertreatment designed to reduce diesel PM, the diesel oxidation catalyst (DOC) and the diesel particulate filter (DPF). DOCs reduce diesel PM by oxidizing a small fraction of the soot emissions and a significant portion of the SOF emissions. Total DOC effectiveness to reduce PM emissions is normally limited to approximately 30 percent because the SOF portion of diesel PM for modern diesel engines is typically less than 30 percent and because the DOC increases sulfate emissions reducing the overall effectiveness of the catalyst. Limiting fuel sulfur levels to 15ppm, as we have proposed today, allows DOCs to be designed for maximum effectiveness (nearly 100% control of SOF with highly active catalyst technologies) since their control effectiveness is not reduced by sulfate make (i.e., there sulfate make rate is high but because the sulfur level in the fuel is low the resulting PM emissions are well controlled). A reduction in diesel fuel sulfur to 500 ppm as we are proposing today, is also directionally helpful for the application of DOCs. While 500 ppm sulfur fuel will not make the full range of highly active catalyst technologies available to manufacturers, it will decrease the amount of sulfate make and may allow for slightly more active (i.e., effective) catalysts to be used. We believe that this is an additional benefit of the proposed 500 ppm sulfur fuel program. DOCs are also very effective at reducing the air toxic emissions from diesel engines. Test data shows that emissions of toxics such as polycyclic aromatic hydrocarbons (PAHs) can be reduced by more than 80 percent with a DOC.[132] DOCs also significantly reduce (by more than 80 percent) the already low HC and CO emissions of diesel engines.[133] DOCs are ineffective at controlling the solid carbon soot portion of PM. Therefore, even with 15 ppm sulfur fuel DOCs would not be able to achieve the level of PM control needed to meet the standard proposed today.

DPFs control diesel PM by capturing the soot portion of PM in a filter media, typically a ceramic wall flow substrate, and then by oxidizing (burning) it in the oxygen-rich atmosphere of diesel exhaust. The SOF portion of diesel PM can be controlled through the addition of catalytic materials to the DPF to form a catalyzed diesel particulate filter (CDPF).[134] The catalytic material is also very effective to promote soot burning. This burning off of collected PM is referred to as "regeneration." In aggregate over an extended period of operation, the PM must be regenerated at a rate equal to or greater that its accumulation rate, or the DPF will clog. For a non-catalyzed DPF the soot can regenerate only at very high temperatures, in excess of 600˚C, a temperature range which is infrequently realized in normal diesel engine operation (for many engines exhaust

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[132] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels", Manufacturers of Emission Controls Association, June 1999. Air Docket A-2001-28.

[133] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels", Manufacturers of Emission Controls Association, June 1999. Air Docket A-2001-28.

[134] With regard to gaseous emissions such as NMHCs and CO, the CDPF works in the same manner with similar effectiveness as the DOC (i.e., NMHC and CO emissions are reduced by more than 80 percent).

temperatures may never reach 600˚C). With the addition of a catalytic coating to make a CDPF, the temperature necessary to ensure regeneration is decreased significantly to approximately 250˚C, a temperature within the normal operating range for most diesel engines.[135]

However, the catalytic materials that most effectively promote soot and SOF oxidation are significantly impacted by sulfur in diesel fuel. Sulfur both degrades catalyst oxidation efficiency (i.e. poisons the catalyst) and forms sulfate PM. Both catalyst poisoning by sulfur and increases in PM emissions due to sulfate make influence our decision to limit the sulfur level of diesel fuel to 15 ppm as discussed in greater detail in Section III.F.

Filter regeneration is affected by catalytic materials used to promote oxidation, sulfur in diesel fuel, engine-out soot rates, and exhaust temperatures. At higher exhaust temperatures soot oxidation occurs at a higher rate. Catalytic materials accelerate soot oxidation at a single exhaust temperature compared to non-catalyst DPFs, but even with catalytic materials increasing the exhaust temperature further accelerates soot oxidation.

Having applied 15 ppm sulfur diesel fuel and the best catalyst technology to promote low temperature oxidation (regeneration), the regeneration balance of soot oxidation equal to or greater than soot accumulation over aggregate operation simplifies to: are the exhaust temperatures high enough on aggregate to oxidize the engine-out PM rate?[136] The answer is yes, for most highway applications and many nonroad applications, as demonstrated by the widespread success of retrofit CDPF systems for nonroad equipment and the use of both retrofit and original equipment CDPF systems for highway vehicles.[137,138,139] However, it is possible that for some nonroad applications the engine-out PM rate may exceed the soot oxidation rate, even with low sulfur diesel fuel and the best catalyst technologies. Should this occur, successful regeneration requires that either engine-out PM rates be decreased or exhaust temperatures be increased, both feasible strategies. In fact, we expect both to occur as highway based technologies are transferred to nonroad engines. As discussed earlier, engine technologies to lower PM emissions while improving fuel consumption are continuously being developed and refined. As these technologies are applied to nonroad engines driven by both new emission standards and market pressures for better products, engine-out PM rates will decrease. Similarly, techniques to raise exhaust

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[135] Engelhard DPX catalyzed diesel particulate filter retrofit verification, www.epa.gov/otaq/retrofit/techlist-engelhard.htm, a copy of this information is available in Air Docket A-2001-28.

[136] If the question was asked, "without 15 ppm sulfur fuel and the best catalyst technology, are the exhaust temperatures high enough on aggregate to oxidize the engine-out PM rate?" the answer would be no, for all but a very few nonroad or highway diesel engines.

[137] "Particulate Traps for Construction Machines, Properties and Field Experience," 2000, SAE 2000-01-1923.

[138] Letter from Dr. Barry Cooper, Johnson Matthey, to Don Kopinski, US EPA. Copy available in EPA Air Docket A-2001-28.

[139] EPA Recognizes Green Diesel Technology Vehicles at Washington Ceremony, Press Release from International Truck and Engine Company, July 27, 2001. Copy available in EPA Air Docket A-2001-28.

temperatures periodically in order to initiate soot oxidation in a PM filter have been developed for highway diesel vehicles as typified by the PSA system used on more than 400,000 vehicles in Europe.[140, 141]

During our 2002 Highway Diesel Progress Review, we investigated the plans of highway engine manufacturers to use CDPF systems to comply with the HD2007 emission standards for PM. We learned that all diesel engine manufacturers intend to comply through the application of CDPF system technology. We also learned that the manufacturers are developing means to raise the exhaust temperature, if necessary, to ensure that CDPF regeneration occurs.[142] These technologies include modifications to fuel injection strategies, modifications to EGR strategies, and modifications to turbocharger control strategies. These systems are based upon the technologies used by the engine manufacturers to comply with the 2004 highway emission standards. In general, the systems anticipated to be used by highway manufacturers to meet the 2004 emission standards are the same technologies that engine manufacturers have indicated to EPA that they will use to comply with the Tier 3 nonroad regulations (e.g., electronic fuel systems).[143] In a manner similar to highway engine manufacturers, we expect nonroad engine manufacturers to adapt their Tier 3 emission control technologies to provide back-up regeneration systems for CDPF technologies in order to comply with the standards we are proposing today. We have estimated costs for such systems in our cost analysis.

Emission levels from CDPFs are determined by a number of factors. Filtering efficiencies for solid particle emissions like soot are determined by the characteristics of the PM filter, including wall thickness and pore size. Filtering efficiencies for diesel soot can be 99 percent with the appropriate filter design.[144] Given an appropriate PM filter design the contribution of the soot portion of PM to the total PM emissions are negligible (less than 0.001 g/bhp-hr). This level

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140 There is one important distinction between the current PSA system and the kind of system that we project industry will use to comply with the Tier 4 standards. The PSA system incorporates a cerium fuel additive to help promote soot oxidation. The additive serves a similar function to a catalyst to promote soot oxidation at lower temperatures. Even with the use of the fuel additive passive regeneration is not realized on the PSA system and an active regeneration is conducted periodically involving late cycle fuel injection and oxidation of the fuel on an up-front diesel oxidation catalyst to raise exhaust temperatures. This form of supplemental heating to ensure infrequent but periodic PM filter regeneration has proven to be robust and reliable for more than 400,000 PSA vehicles. Our 2002 progress review found that other manufacturers will be introducing similar systems in the next few years without the use of a fuel additive.

141 Nino, S. and Lagarrigue, M. “French Perspective on Diesel Engines and Emissions,” presentation at the 2002 Diesel Engine Emission Reduction workshop in San Diego, California, Air Docket A-2001-28.

142 Highway Diesel Progress Review, United States Environmental Protection Agency, June 2002, EPA 420-R-02-016. Copy available in EPA Air Docket A-2001-28.

143 “Nonroad Diesel Emissions Standards Staff Technical Paper”, EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

144 Miller, R. et. al, “Design, Development and Performance of a Composite Diesel Particulate Filter,” March 2002, SAE 2002-01-0323.

of soot emission control is not dependent on engine test cycle or operating conditions due to the mechanical filtration characteristics of the particulate filter.

Control of the SOF portion of diesel soot is accomplished on a CDPF through catalytic oxidation. The SOF portion of diesel PM consists of primarily gas phase hydrocarbons in engine exhaust due to the high temperatures and only forms particulate in the environment when it condenses. Catalytic materials applied to CDPFs can oxidize a substantial fraction of the SOF in diesel PM just as the SOF portion would be oxidized by a DOC. However, we believe that for engines with very high SOF emissions the emission rate may be higher than can be handled by a conventionally sized catalyst resulting in higher than zero SOF emissions. If a manufacturer's base engine technology has high oil consumption rates, and therefore high engine-out SOF emissions (i.e., higher than 0.04 g/bhp-hr), compliance with the 0.01 g/bhp-hr emission standard proposed today may require additional technology beyond the application of a CDPF system alone.[145]

Modern highway diesel engines have controlled SOF emission rates in order to comply with the existing 0.1 g/bhp-hr emission standards. For modern highway diesel engines, the SOF portion of PM is typically on a small fraction of the total PM emissions (less than 0.02 g/bhp-hr). This level of SOF control is accomplished by controlling oil consumption through the use of engine modifications (e.g., piston ring design, the use of 4-valve heads, the use of valve stem seals, etc.).[146] Nonroad diesel engines may similarly need to control engine-out SOF emissions in order to comply with the standard proposed today. The means to control engine-out SOF emissions are well known and have additional benefits, as they decrease oil consumption reducing operating costs. With good engine-out SOF control (i.e., engine-out SOF < 0.02 g/bhp-hr) and the application of catalytic material to the DPF, SOF emissions from CDPF equipped nonroad engines will contribute only a very small fraction of the total tailpipe PM emissions (less than 0.004 g/bhp-hr). Alternatively, it may be less expensive or more practical for some applications to ensure that the SOF control realized by the CDPF is in excess of 90 percent, thereby allowing for higher engine-out SOF emission levels.

The best means to reduce sulfate emissions from diesel engines is by reducing the sulfur content of diesel fuel and lubricating oils. This is one of the reasons that we have proposed today to limit nonroad diesel fuel sulfur levels to be 15ppm or less. The catalytic material on the CDPF is crucial to ensuring robust regeneration and high SOF oxidation; however, it can also oxidize the sulfate in the exhaust with high efficiency. The result is that the predominant form of PM emissions from CDPF equipped diesel engines is sulfate PM. Even with 15ppm sulfur diesel fuel a CDPF equipped diesel engine can have total PM emissions including sulfate emissions as high

[145] SOF oxidation efficiency is typically better than 80 percent and can be better than 90 percent. Given a base engine SOF rate of 0.04 g/bhp-hr and an 80 percent SOF reduction a tailpipe emission of 0.008 can be estimated from SOF alone. This level may be too high to comply with a 0.01 g/bhp-hr standard once the other constituents of diesel PM (soot and sulfate) are added. In this case, SOF emissions will need to be reduced engine-out or SOF control greater than 90 percent will need to be realized by the CDPF.

[146] Hori, S. and Narusawa, K. "Fuel Composition Effects on SOF and PAH Exhaust Emissions from DI Diesel Engines," SAE 980507.

as 0.009 g/bhp-hr over some representative operating cycles using conventional diesel engine oils.[147] Although this level of emissions will allow for compliance with our proposed PM emissions standard of 0.01 g/bhp-hr, we believe that there is room for reductions from this level in order to provide engine manufacturers with additional compliance margin. During our 2002 Highway Progress Review, we learned that a number of engine lubricating oil companies are working to reduce the sulfur content in engine lubricating oils. Any reduction in the sulfur level of engine lubricating oils will be beneficial. Similarly, as discussed above, we expect engine manufacturers to reduce engine oil consumption in order to reduce SOF emissions and secondarily to reduce sulfate PM emissions. While we believe that sulfate PM emissions will be the single largest source of the total PM from diesel engines, we believe with the combination of technology, and the appropriate control of engine-out PM, that sulfate and total PM emissions will be low enough to allow compliance with a 0.01 g/bhp-hr standard, except in the case of small engines with higher fuel consumption rates as described later in this section.

CDPFs have been shown to be very effective at reducing PM mass by reducing dramatically the soot and SOF portions of diesel PM. In addition, recent data show that they are also very effective at reducing the overall number of emitted particles when operated on low sulfur fuel. Hawker, et. al., found that a CDPF reduced particle count by over 95 percent, including some of the smallest measurable particles (< 50 nm), at most of the tested conditions. The lowest observed efficiency in reducing particle number was 86 percent. No generation of particles by the CDPF was observed under any tested conditions.[148] Kittelson, et al., confirmed that ultrafine particles can be reduced by a factor of ten by oxidizing volatile organics, and by an additional factor of ten by reducing sulfur in the fuel. Catalyzed PM traps efficiently oxidize nearly all of the volatile organic PM precursors (i.e. SOF), and the reduction of diesel fuel sulfur levels to 15ppm or less will substantially reduce the number of ultrafine PM emitted from diesel engines. The combination of CDPFs with low sulfur fuel is expected to result in very large reductions in both PM mass and the number of ultrafine particles.

As described here, the range of technologies available to reduce PM emissions is broad, extending from improvements to existing combustion system technologies to oxidation catalyst technologies to complete CDPF systems. The CDPF technology along with 15ppm or less sulfur diesel fuel is the system that we believe will allow engine manufacturers to comply with the 0.01 g/bhp-hr PM standard that we have proposed for a wide range of nonroad diesel engines. While it may be possible to apply CDPFs across the full range of nonroad diesel engine sizes, the complexity of full diesel particulate filter systems makes application to the smallest range of diesel engines difficult to accurately forecast at this time. As described in the following sections, the Agency has given consideration to the engineering complexity, cost and packaging of these systems in setting emission standards for various nonroad engine power categories.

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[147] See Table III.F.1 below

[148] Hawker, P., et. al., Effect of a Continuously Regenerating Diesel Particulate Filter on Non-Regulated Emissions and Particle Size Distribution, SAE 980189.

b. NOx Control Technologies

Oxides of nitrogen (NO and NO_2, collectively called NOx) are formed at high temperatures during the combustion process from nitrogen and oxygen present in the intake air. The NOx formation rate is exponentially related to peak cylinder temperatures and is also strongly related to nitrogen and oxygen content (partial pressures). NOx control technologies for diesel engines have focused on reducing emissions by lowering the peak cylinder temperatures and by decreasing the oxygen content of the intake air. A number of technologies have been developed to accomplish these objectives including fuel injection timing retard, fuel injection rate control, charge air cooling, exhaust gas recirculation (EGR) and cooled EGR. The use of these technologies can result in significant reductions in NOx emissions, but are limited due to practical and physical constraints of heterogeneous diesel combustion.[149,150]

EPA is investigating strategies to address these limitations of heterogenous diesel combustion in a research program. This concept consists of higher intake charge boost levels using a low-pressure loop cooled EGR system, combined with a proprietary fuel injection and combustion system to control engine-out NOx.[151] The results from prototype laboratory research engines show NOx control consistent with the standards proposed today. The technology must still overcome the limitations of increased PM emissions at low NOx levels as well as other practical considerations of performance and durability. EPA intends to continue investigating this technology, but at this time cannot project that this technology would be generally available for use in compliance with the proposed standards.

A new form of diesel engine combustion, commonly referred to as homogenous diesel combustion or premixed diesel combustion, can give very low NOx emissions over a limited range of diesel engine operation. In the regions of diesel engine operation over which this combustion technology is feasible (light load conditions), NOx emissions can be reduced enough to comply with the 0.3 g/bhp-hr NOx emission standard that we have proposed today.[152] Some engine manufacturers are today producing engines which utilize this technology over a narrow range of engine operation.[153] Unfortunately, it is not possible today to apply this technology over the full range of diesel engine operation. We do believe that more engine manufacturers will

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[149] Flynn, P. et al, "Minimum Engine Flame Temperature Impacts on Diesel and Spark-Ignition Engine NOx Production," SAE 2000-01-1177, March 2000.

[150] Dickey, D. et al, "NOx Control in Heavy-Duty Diesel Engines - What is the Limit?," SAE 980174, February 1998.

[151] Gray, Charles "Assessing New Diesel Technologies," November 2002, MIT Light Duty Diesel Workshop, available on MIT's website or in Air Docket A-2001-28. http://web.mit.edu/chrisng/www/dieselworkshop_files/Charles%20Gray.PDF

[152] Stanglmaier, Rudolf and Roberts, Charles "Homogenous Charge Compression Ignition (HCCI): Benefits, Compromises, and Future Engine Applications". SAE 1999-01-3682.

[153] Kimura, Shuji, et al., "Ultra-Clean Combustion Technology Combining a Low-Temperature and Premixed Combustion Concept for Meeting Future Emission Standards", SAE 2001-01-0200.

utilize this alternative combustion approach in the limited range over which it is effective, but will have to rely on conventional heterogenous diesel combustion for the bulk of engine operation. Therefore, we believe that catalytic NOx emission control technologies will be required in order to realize the NOx emission standards proposed today. Catalytic emission control technologies can extend the reduction of NOx emissions by an additional 90 percent or more over conventional "engine-out" control technologies alone.

NOx emissions from gasoline-powered vehicles are controlled to extremely low levels through the use of the three-way catalyst technology first introduced in the 1970s. Three-way-catalyst technology is very efficient in the stoichiometric conditions found in the exhaust of properly controlled gasoline-powered vehicles. Today, an advancement upon this well-developed three-way catalyst technology, the NOx adsorber, has shown that it too can make possible extremely low NOx emissions from lean-burn engines such as diesel engines.[154] The potential of the NOx adsorber catalyst is limited only by its need for careful integration with the engine and engine control system (as was done for three-way catalyst equipped passenger cars in the 1980s and 1990s) and by poisoning of the catalyst from sulfur in the fuel. The Agency set stringent new NOx standards for highway diesel engines beginning in 2007 predicated upon the use of the NOx adsorber catalyst enabled by significant reductions in fuel sulfur levels (15 ppm sulfur or less). In today's action, we are proposing similarly stringent NOx emission standards for nonroad engines again using technology enabled by a reduction in fuel sulfur levels.

NOx adsorbers work to control NOx emissions by storing NOx on the surface of the catalyst during the lean engine operation typical of diesel engines. The adsorber then undergoes subsequent brief rich regeneration events where the NOx is released and reduced across precious metal catalysts. The NOx storage period can be as short as 15 seconds and as along as 10 minutes depending upon engine-out NOx emission rates and exhaust temperature. A number of methods have been developed to accomplish the necessary brief rich exhaust conditions necessary to regenerate the NOx adsorber technology including late-cycle fuel injection, also called post injection, in exhaust fuel injection, and dual bed technologies with off-line regeneration.[155,156,157] This method for NOx control has been shown to be highly effective when applied to diesel engines but has a number of technical challenges associated with it. Primary among these is sulfur poisoning of the catalyst as described in Section III.F below. In the HD2007 RIA we identified four issues related to NOx adsorber performance: performance of the catalyst across a broad range of exhaust temperatures, thermal durability of the catalyst when regenerated to

[154] NOx adsorber catalysts are also called, NOx storage catalysts (NSCs), NOx storage and reduction catalysts (NSRs), and NOx traps.

[155] Johnson, T. "Diesel Emission Control in Review - the Last 12 Months," SAE 2003-01-0039.

[156] Koichiro Nakatani, Shinya Hirota, Shinichi Takeshima, Kazuhiro Itoh, Toshiaki Tanaka, and Kazuhiko Dohmae, "Simultaneous PM and NOx Reduction System for Diesel Engines.", SAE 2002-01-0957, SAE Congress March 2002.

[157] Schenk, C., McDonald, J. and Olson, B. "High Efficiency NOx and PM Exhaust Emission Control for Heavy-Duty On-Highway Diesel Engines," SAE 2001-01-1351.

remove sulfur (desulfated), management of sulfur poisoning, and system integration on a vehicle. In the HD 2007 RIA, we provided a description of the technology paths that we believed manufacturers would use to address these challenges. We are conducting an ongoing review of industry's progress to overcome these challenges and have updated our analysis of the progress to address these issues in the draft RIA associated with today's NPRM.

One of the areas that we have identified as needing improvement for the NOx adsorber catalyst is performance at low and high exhaust temperatures. NOx adsorber performance is limited at very high temperatures (due to thermal release of NOx under lean conditions) and very low temperatures (due to poor catalytic activity for NO oxidation under lean conditions and low activity for NOx reduction under rich conditions) as described extensively in the draft RIA. Our review of highway HD2007 technologies showed that significant progress has been made to broaden the temperature range of effective NOx control of the NOx adsorber catalysts (the temperature "window" of the catalyst). Every catalyst development company that we visited was able to show us new catalyst formulations with improved performance at both high and low temperatures. Similarly, many of the engine manufacturers we visited showed us data indicating that the improvements in catalyst formulations corresponded to improvements in emission reductions over the regulated test cycles. It is clear from the data presented to EPA that the progress with regard to NOx adsorber performance has been both substantial and broadly realized by most technology developers. The importance of this temperature window to nonroad engine manufacturers is discussed in more detail later in this section.

Long term durability has been the greatest concern for the NOx adsorber catalyst. We have concluded as described briefly in III.F below and in some detail in the draft RIA, that in order for NOx adsorbers to effectively control NOx emission throughout the life of a nonroad diesel engine the fuel sulfur level will have to be maintained at or below 15 ppm, that the NOx adsorber catalyst thermal durability will need to improve in order to allow for sulfur regeneration events (since adsorber thermal degradation, "sintering," is associated with each desulfation event, the number of desulfation events should be minimized), and that system improvements will have to be made in order to allow for appropriate management of sulfur poisoning. It is in this area of durability that NOx adsorbers had the greatest need for improvement, and it is here where some of the most impressive ongoing strides in technology development have been made. During our ongoing review, we have learned that catalyst companies are making significant improvements in the thermal durability of the catalyst materials used in NOx adsorbers. Similarly, the substrate manufacturers are developing new materials that address the problem of NOx storage material migration into the substrate.[158] The net gain from these simultaneous improvements are NOx adsorber catalysts which can be desulfated (go through a sulfur regeneration process) with significantly lower levels of thermal damage to the catalyst function. In addition, engine manufacturers and emission control technology vendors are developing new strategies to accomplish desulfation that allow for improved sulfur management while minimizing the damage due to sulfur poisoning. It was clear in our review that the total system improvements being made

[158] Some NOx storage materials can interact with the catalyst substrate especially at elevated temperatures making the storage material unavailable for NOx storage and weakening the substrate.

when coupled with changes to catalytic materials and catalyst substrates are delivering significantly improved catalyst durability to the NOx adsorber technology.

Practical application of the NOx adsorber catalyst in a vehicle was an issue during the HD2007 rulemaking and similarly there are issues regarding the application of NOx adsorbers to nonroad equipment. Although there is considerable evidence that NOx adsorbers are highly effective and that durability issues can be addressed, some worry that the application of the NOx adsorber systems to vehicles and nonroad equipment will be impractical due to packaging constraints and the potential for high fuel consumption. Our review of progress has left us more certain than ever that practical system solutions can be applied to control emissions using NOx adsorbers. We have tested a diesel passenger car (one of the most difficult packaging situations) with a complete NOx adsorber and particulate filter system that demonstrated both exceptional emission control and very low fuel consumption.[159] Heavy-duty engine manufacturers have shared with us their improvements in system design and means to regenerate NOx while minimizing fuel consumption.[160] Our own in-house testing program at the National Vehicle and Fuel Emissions Laboratory (NVFEL) is developing a number of novel ideas to reduce the total system package size while maintaining high levels of emission control and low fuel consumption rates as discussed more fully in the draft RIA. Similarly, a number of Department of Energy (DOE), Advanced Petroleum Based Fuel - Diesel Emission Control (APBF-DEC) program NOx adsorber projects are working to address the system integration challenges for a diesel passenger car, a large sport utility vehicle and for a heavy heavy-duty truck.[161] By citing these numerous examples, we are not intending to imply that the challenge of integrating and packaging advanced emission control technologies is easy. Rather, we believe these examples show that even though significant challenges exist, they can be overcome through careful design and integration efforts. Nonroad equipment manufacturers have addressed similar challenges in the past when they have added additional customer features (e.g., packaged an air-conditioning system) or in accommodating other emission control technologies (e.g., charge air cooling systems).

All of the issues described above and highlighted first during the HD2007 rulemaking are likely to be concerns to nonroad engine and nonroad equipment manufacturers. We believe the challenge to overcome these issues will be significant for nonroad engines and equipment. Yet, we have documented substantial progress by industry in the last year to overcome these challenges, and we continue to believe based on the progress we have observed that the NOx adsorber catalyst technology will be mature enough for application to many diesel engines by 2007. In the case of NOx adsorber temperature window, which could be especially challenging

[159] McDonald, J and Bunker, B. "Testing of the Toyota Avensis DPNR at U.S. EPA-NVFEL," SAE 2002-01-2877.

[160] Hakim, N. "NOx Adsorbers for Heavy Duty Truck Engines - Testing and Simulation," presentation at Motor Fuels: Effects on Energy Efficiency and Emissions in the Transportation Sector Joint Meeting of Research Program Sponsored by the USA Dept. of Energy, Clean Air for Europe and Japan Clean Air, October 9-10, 2002. Copy available in EPA Air Docket A-2001-28.

[161] Details with quarterly updates on the APBF-DEC programs can be found on the DOE website at the following location http://www.ott.doe.gov/apbf.shtml.

for nonroad engines, we have performed an analysis summarized below in Section III.E.2 and documented in the draft RIA, that leads us to conclude the technology can be successfully applied to nonroad engines provided there is some additional lead time for further engine and catalyst system technology development. Similarly, we acknowledge that the diverse nature and sheer number of different nonroad equipment types makes the challenge of packaging advanced emission control technologies more difficult. Therefore, we have included a number of equipment manufacturer flexibilities in the program proposed today in order to allow equipment manufacturers to manage the engineering resource challenges imposed by these regulations.

Another NOx catalyst based emission control technology is selective catalytic reduction (SCR). SCR catalysts require a reductant, ammonia, to reduce NOx emissions. Because of the significant safety concerns with handling and storing ammonia, most SCR systems make ammonia within the catalyst system from urea. Such systems are commonly called urea SCR systems. (Throughout this document the term SCR and urea SCR may be used interchangeably and should be considered as referring to the same urea based catalyst system.) With the appropriate control system to meter urea in proportion to engine-out NOx emissions, urea SCR catalysts can reduce NOx emissions by over 90 percent for a significant fraction of the diesel engine operating range.[162] Although EPA has not done an extensive analysis to evaluate its effectiveness, we believe it may be possible to reduce NOx emissions with a urea SCR catalyst to levels consistent with compliance with the proposed NOx standards.

However, we have significant concerns regarding a technology that requires extensive user intervention in order to function properly and the lack of the urea delivery infrastructure necessary to support this technology. Urea SCR systems consume urea in proportion to the engine-out NOx rate. The urea consumption rate can be on the order of five percent of the engine fuel consumption rate. Therefore, unless the urea tank is prohibitively large, the urea must be replenished frequently. Most urea systems are designed to be replenished every time fuel is added or at most every few times that fuel is added. Today, there is not a system in place to deliver or dispense automotive grade urea to diesel fueling stations. One study conducted for the National Renewable Energy Laboratory (NREL), estimated that if urea were to be distributed to every diesel fuel station in the United States, the cost would be more than $30 per gallon.[163]

We are not aware of a proven mechanism that ensures that the user will replenish the urea supply as necessary to maintain emissions performance. Further, we believe given the additional cost for urea, that there will be significant disincentives for the end-user to appropriately replenish the urea because the cost of urea could be avoided without equipment performance loss. See NRDC v. EPA, 655 F. 2d 318, 332 (D.C. Cir. 1981) (referring to "behavioral barriers to periodic

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[162] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels", Manufacturers of Emissions Controls Association, June 1999 Air Docket A-2001-28.

[163] Fable, S. et al, "Subcontractor Report - Selective Catalytic Reduction Infrastructure Study," AD Little under contract to National Renewable Energy Laboratory, July 2002, NREL/SR-5040-32689. Copy available in EPA Air Docket A-2001-28.

restoration of a filter by a [vehicle] owner" as a valid basis for EPA considering a technology unavailable). Due to the lack of an infrastructure to deliver the needed urea, and the lack of a track record of successful ways to ensure urea use, we have concluded that the urea SCR technology is not likely to be available for general use in the time frame of the proposed standards. Therefore, we have not based the feasibility or cost analysis of this emission control program on the use or availability of the urea SCR technology. However, we would not preclude its use for compliance with the emission standards provided that a manufacturer could demonstrate satisfactorily to the Agency that urea would be used under all conditions. We believe that only a few unique applications will be able to be controlled in a manner such that urea use can be assured, and therefore believe it is inappropriate to base a national emission control program on a technology which can serve effectively only in a few niche applications.

This section has described a number of technologies that can reduce emissions from diesel engines. The following section describes the challenges to applying these diesel engine technologies to engines and equipment designed for nonroad applications.

2. Can These Technologies Be Applied to Nonroad Engines and Equipment?

The emission standards and the introduction dates for those standards, as described earlier in this section, are premised on the transfer of diesel engine technologies being or already developed to meet light-duty and heavy-duty vehicle standards that begin in 2007. The standards that we are proposing today for engines $\geq$75 horsepower will begin to go into effect four years later. This time lag between equivalent highway and nonroad diesel engine standards is necessary in order to allow time for engine and equipment manufacturers to further develop these highway technologies for nonroad engines and to align this program with nonroad Tier 3 emission standards that begin to go into effect in 2006.

As discussed previously, the test procedures and regulations for the HD2007 highway engines include a transient test procedure, a broad steady-state procedure, and NTE provisions that require compliant engines to emit at or below 1.5 times the regulated emission levels under virtually all conditions. An engine designed to comply with the 2007 highway emission standards would comply with the equivalent nonroad emission standards proposed today if it were to be tested over the transient and steady-state nonroad emission test procedures proposed today, which cover the same regions and types of engine operation. Said in another way, a highway diesel engine produced in 2007 could be certified in compliance with the transient and steady-state standards proposed today for nonroad diesel engines several years in advance of the date when these standards would go into effect. However, that engine, while compliant with certain of the nonroad emission standards proposed today, would not necessarily be designed to address the various durability and performance requirements of many nonroad equipment manufacturers. We expect that the engine manufacturers will need additional time to further develop the necessary emission control systems to address some of the nonroad issues described below as well as to develop the appropriate calibrations for engine rated speed and torque characteristics required by the diverse range of nonroad equipment. Furthermore, not all nonroad engine manufacturers produce highway diesel engines or produce nonroad engines that are developed from highway products. Therefore, there is a need for lead time between the Tier 3 emission standards which go into effect in 2006-2008 and the Tier 4 emission standards. We believe the technologies developed to comply with the Tier 3 emission standards such as improved air handling systems and electronic fuel systems will form an essential technology baseline which manufacturers will need to initiate and control the various regeneration functions required of the catalyst based technologies for Tier 4. The Agency has given consideration to all of these issues in setting the emission standards and the timing of those standards as proposed today.

This section describes some of the challenges to applying advanced emission control technologies to nonroad engines and equipment, and why we believe that technologies developed for highway diesel engines can be further refined to address these issues in a timely manner for nonroad engines consistent with the emission standards proposed today. This section paraphrases a more in-depth analysis in the draft RIA.

a. Nonroad Operating Conditions and Exhaust Temperatures

Nonroad equipment is highly diverse in design, application, and typical operating conditions. This variety of operating conditions affects emission control systems through the resulting variety in the torque and speed demands (i.e. power demands). This wide range in what constitutes typical nonroad operation makes the design and implementation of advanced emission control technologies more difficult. The primary concern for catalyst based emission control technologies is exhaust temperature. In general, exhaust temperature increases with engine power and can vary dramatically as engine power demands vary.

For most catalytic emission control technologies there is a minimum temperature below which the chemical reactions necessary for emission control do not occur. The temperature above which substantial catalytic activity is realized is often called the light-off temperature. For gasoline engines, the light-off temperature is typically only important in determining cold start emissions. Once gasoline vehicle exhaust temperatures exceed the light-off temperature, the catalyst is "lit-off" and remains fully functional under all operating conditions. Diesel exhaust is significantly cooler than gasoline exhaust due to the diesel engine's higher thermal efficiency and its operation under predominantly lean conditions. Absent control action taken by an electronic engine control system, diesel exhaust may fall below the light-off temperature of catalyst technology even when the vehicle is fully warmed up.

The relationship between the exhaust temperature of a nonroad diesel engine and light-off temperature is an important factor for both CDPF and NOx adsorber technologies. For the CDPF technology, exhaust temperature determines the rate of filter regeneration and if too low causes a need for supplemental means to ensure proper filter regeneration. In the case of the CDPF, it is the aggregate soot regeneration rate that is important, not the regeneration rate at any particular moment in time. A CDPF controls PM emissions under all conditions and can function properly (i.e., not plug) even when exhaust temperatures are low for an extended time and the regeneration rate is lower than the soot accumulation rate, provided that occasionally exhaust temperatures and thus the soot regeneration rate are increased enough to regenerate the CDPF. A CDPF can passively (without supplemental heat addition) regenerate if exhaust temperatures remain above

250˚C for more than 30 percent of engine operation.[164] Similarly, there is a minimum temperature (e.g., 200˚C) for NOx adsorbers below which NOx regeneration is not readily possible and a maximum temperature (e.g., 500˚C) above which NOx adsorbers are unable to effectively store NOx. These minimum and maximum temperatures define a characteristic temperature window of the NOx adsorber catalyst. When the exhaust temperature is within the temperature window (above the minimum and below the maximum) the catalyst is highly effective. When exhaust temperatures fall outside this window of operation, NOx adsorber effectiveness is diminished. Therefore, there is a need to match diesel exhaust temperatures to conditions for effective catalyst operation under the various operating conditions of nonroad engines.

Although the range of products for highway vehicles is not as diverse as for nonroad equipment, the need to match exhaust temperatures to catalyst characteristics is still present. This is a significant concern for highway engine manufacturers and has been a focus of our ongoing diesel engine progress review. There we have learned that substantial progress is being made to broaden the operating temperature window of catalyst technologies while at the same time engine systems are being designed to better control exhaust temperatures. Highway diesel engine manufacturers are working to address this need through modifications to engine design, modifications to engine control strategies and modifications to exhaust system designs. Engine design changes, including the ability for multiple late fuel injections and the ability to control total air flow into the engine, give controls engineers additional flexibility to change exhaust temperature characteristics. Modifications to the exhaust system, including the use of insulated exhaust manifolds and exhaust tubing, can help to preserve the temperature of the exhaust gases. New engine control strategies designed to take advantage of engine and exhaust system modifications can then be used to manage exhaust temperatures across a broad range of engine operation. The technology solutions being developed for highway engines to better manage exhaust temperature are built upon the same emission control technologies (i.e., advanced air handling systems and electronic fuel injection systems) that we expect nonroad engine manufacturers to use in order to comply with the Tier 3 emission standards.

Matching the operating temperature window of the broad range of nonroad equipment may be somewhat more challenging for nonroad engines than for many highway diesel engines simply because of the diversity in equipment design and equipment use. Nonetheless, the problem has been successfully solved in highway applications facing low temperature performance situations as difficult to address as any encountered by nonroad applications. The most challenging temperature regime for highway engines are encountered at very light-loads as typified by congested urban driving. Under congested urban driving conditions exhaust temperatures may be too low for effective NOx reduction with a NOx adsorber catalyst. Similarly, exhaust temperatures may be too low to ensure passive CDPF regeneration. To address these concerns, light-duty diesel engine manufacturers have developed active temperature management strategies that provide effective emissions control even under these difficult light-load conditions. Toyota has shown with their prototype DPNR vehicles that changes to EGR and fuel injection strategies

[164] Engelhard DPX catalyzed diesel particulate filter retrofit verification, www.epa.gov/otaq/retrofit/techlist-engelhard.htm, a copy of this information is available in Air Docket A-2001-28.

can realize an increase in exhaust temperatures of more than 100˚F under even very light-load conditions allowing the NOx adsorber catalyst to function under these normally cold exhaust conditions.[165] Similarly, PSA has demonstrated effective CDPF regeneration under demanding light-load taxi cab conditions with current production technologies.[166] Both of these are examples of technology paths available to nonroad engine manufacturers to increase temperatures under light-load conditions.

We are not aware of any nonroad equipment in-use operating cycles which would be more demanding of low temperature performance than passenger car urban driving. Both the Toyota and PSA systems are designed to function even with extended idle operation as would be typified by a taxi waiting to pick up a fare. By actively managing exhaust temperatures engine manufacturers can ensure highly effective catalyst based emission control performance (i.e., compliance with the emission standards) and reliable filter regeneration (failsafe operation) across a wide range of engine operation as would be typified by the broad range of in-use nonroad duty cycles and the new nonroad transient test proposed today.

The systems described here from Toyota and PSA are examples of highly integrated engine and exhaust emission control systems based upon active engine management designed to facilitate catalyst function. Because these systems are based upon the same engine control technologies likely to be used to comply with the Tier 3 standards and because they allow great flexibility to trade-off engine control and catalyst control approaches depending on operating mode and need, we believe most nonroad engine manufacturers will use similar approaches to comply with the emission standards proposed today. However, there are other technologies available that are designed to be added to existing engines without the need for extensive integration and engine management strategies. One example of such a system is an active DPF system developed by Deutz for use on a wide range on nonroad equipment. The Deutz system has been sold as an OEM retrofit technology that does not require changes to the base engine technology. The system is electronically controlled and uses supplemental in-exhaust fuel injection to raise exhaust temperatures periodically to regenerate the DPF. Deutz has sold over 2,000 of these units and reports that the systems have been reliable and effective. Some manufacturers may choose to use this approach for compliance with the PM standard proposed today, especially in the case of engines which may be able to comply with the proposed NOx standards with engine-out emission control technologies (i.e., engines rated between 25 and 75 horsepower).

High temperature operating regimes such as a heavy heavy-duty diesel truck at full payload driving up a grade are also challenging for the NOx catalyst technology. Although less common, similar high temperature conditions of full engine load operation can be imagined for

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165 Sasaki, S., Ito, T., and Iguchi, S., “Smoke-less Rich Combustion by Low Temperature Oxidation in Diesel Engines,” 9th Aachener Kolloquim Fahrzeug - und Motorentechnik 2000. Copy available in EPA Air Docket A-2001-28.

166 Jeuland, N., et al, “Performances and Durability of DPF (Diesel Particulate Filter) Tested on a Fleet of Peugeot 607 Taxis First and Second Test Phases Results,” October 2002, SAE 2002-01-2790.

nonroad equipment. However, because highway engines typically have higher power density (defined as rated power divided by engine displacement), the highest operating conditions would be expected to be encountered with highway vehicles. High exhaust temperatures (in excess of 500˚C) are challenging for the NOx adsorber catalyst technology because the stored NOx emissions can be released thermally without going through a reduction step, leading to increased NOx emissions. In the absence of a reductant (normally provided by the standard NOx regeneration function) the thermally released NOx is emitted from the exhaust system without treatment. To address this issue, NOx storage catalyst technologies with higher levels of thermal stability are being developed, but these technologies trade-off improved high temperature performance for even greater sensitivity to fuel sulfur. Beyond catalyst improvements, the exhaust temperature from the engine can be controlled prior to the NOx adsorber catalyst simply through heat loss in the exhaust system (i.e. by locating the catalyst further from the engine). Another approach being considered for GDI vehicle applications which operate at much higher temperatures than would be encountered by a diesel engine is to use a relatively simple exhaust layout design to increase heat loss at high temperatures while still providing acceptable low temperature performance.[167] Additionally, exhaust temperatures well in excess of 500˚C are not frequently experienced by nonroad engines. Higher exhaust temperatures would be expected from naturally aspirated engines due to their lower air flow (for the same power / heat input, naturally aspirated engines have less air to heat up and thus the exhaust reaches a higher temperature). Today, less than ten percent of nonroad diesel engines with rated power greater than 100 horsepower are naturally aspirated and we have projected that an even greater percentage of nonroad engines meeting the Tier 3 emission standards will be turbocharged.

We have conducted an analysis of various nonroad equipment operating cycles and various nonroad engine power density levels to better understand the matching of nonroad engine exhaust temperatures, catalyst installation locations and catalyst technologies. This analysis, documented in the draft RIA, showed that for many engine power density levels and equipment operating cycles, exhaust temperatures are quite well matched to catalyst temperature window characteristics. In particular, the nonroad transient cycle (NRTC), the cycle we are proposing to use for certification, was shown to be well matched to the NOx adsorber characteristics with estimated performance in excess of 90 percent for a turbocharged diesel engine tested under a range of power density levels. The analysis also indicated that the exhaust temperatures experienced over the NRTC are better matched to the NOx adsorber catalyst temperature window than the temperatures that would be expected over the highway FTP test cycle. This suggests that compliance with the proposed NRTC will be somewhat easier, using similar technology, than complying with the highway 2007 emission standards on the FTP.

For engines with low power density (e.g., <25 hp per liter of engine displacement) the analysis showed that, absent actions to increase exhaust temperatures (e.g., increased use of EGR a light loads), compliance with the NRTC cycle will be more difficult than for engines with higher power density levels. Specifically, the analysis predicted 92% control for the high power density engine and 86% control for the low power density engine.

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[167] Damson, B., "Exhaust Cooling for NOx-Traps for Lean Spark-Ignition Engines," SAE 2002-01-0737.

Note that this analysis approach is only effective to predict differences in performance, but not effective to predict absolute performance. The same analysis approach predicted 83% control for the high power density engine on the heavy-duty FTP, although testing at EPA has shown for this engine (a different example of this same engine) greater than 90% NOx control.[168] Nevertheless, the analysis suggests that additional attention must be made to designing system for low power density applications, and that technology changes may be necessary to ensure adequate performance (e.g., the use of EGR or other control methods to raise exhaust temperatures). One change, which is occurring independent of EPA's regulation, is increasing power density for nonroad engines. EPA has documented in the draft RIA a clear trend of certified engine ratings that indicates manufacturers are increasing engine power without increasing engine displacement. Engine manufacturers are motivated to increase engine power density because engine pricing is largely done on a power basis, while the cost of manufacturing is more closely related to engine displacement. Therefore, increasing engine power levels without increasing displacement may increase the sale price of the engine more than it increases the cost of manufacturing. Increasing power density typically results in higher exhaust temperatures and, in this case, better matching to catalyst operating requirements. Alternatively, nonroad engine manufacturers can apply the same temperature management strategies previously described for highway engines.

The analysis also suggests that the temperature challenge for nonroad equipment will be greater with regard to the NTE provisions of this proposal than for the nonroad transient test (NRTC) provisions. In fact as discussed previously, the NRTC cycle appears to be a better match to the characteristics of the NOx adsorber catalyst than the FTP cycle used for heavy-duty highway truck certification. This is due to the higher average engine load experienced over the NRTC and thus the higher average temperature. Therefore, we believe that complying with the NOx standard over the transient test cycle proposed today for nonroad engines will not be significantly more difficult than complying with the HD2007 NOx emission standard over the FTP. The analysis also shows that many nonroad engines may operate in-use in a way different from the NRTC (i.e. even the NRTC is not an all-encompassing test; no single test realistically could be), and that NTE standards are therefore needed to assure that nonroad engine emissions are controlled for the full range of possible in-use operating conditions.[169] The technical challenge of controlling NOx emissions, even under these diverse conditions, is no more difficult on a per engine basis than for highway diesel engines which must comply with similar NTE test provisions. This is because both highway and nonroad engine manufacturers must address control at the same high load and low load conditions (minimum power from both are the same, 0 hp, and maximum power is typically higher for highway engines, due to higher power density). Also, both engine manufacturers must be able to respond to changes in user demanded torque (transient conditions) that are similarly unpredictable. However, given the sheer number of different

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[168] Schenk, C., McDonald, J. and Olson, B. "High Efficiency NOx and PM Exhaust Emission Control for Heavy-Duty On-Highway Diesel Engines," SAE 2001-01-1351.

[169] The fact that developing compliant engines for the NTE provisions may be more difficult than developing for the transient test cycle does not diminish the value of the transient test as a means to evaluate the overall effectiveness of the emission control system under transient conditions. There is no doubt that controlling average emissions under transient conditions will be an important part of the emission control system and that evaluating overall performance under transient conditions is needed.

nonroad equipment types and engine ratings, this represents a real challenge for the nonroad industry which is one of the primary considerations given by the Agency in determining the appropriate timing for the emission standards proposed today.

We believe, based on our analysis of nonroad engines and equipment operating characteristics, that in-use some nonroad engines will experience conditions that require the use of temperature management strategies in order to effectively use the NOx adsorber and CDPF systems needed to meet the proposed standards. We have assumed in our cost analysis that all nonroad engines complying with a PM standard of 0.02 g/bhp-hr or lower will have an active means to control temperature (i.e. we have costed a backup regeneration system, although some applications likely may not need one). We have made this assumption believing that manufacturers will not be able to accurately predict in-use conditions for every piece of equipment and will thus choose to provide the technologies on a back-up basis. As explained earlier, the technologies necessary to accomplish this temperature management are enhancements of the Tier 3 emission control technologies that will form the baseline for Tier 4 engines, and the control strategies being developed for highway diesel engines. We do not believe that there are any nonroad engine applications above 25 horsepower for which these highway engine approaches will not work. However, given the diversity in nonroad equipment design and application, we believe that additional time will be needed in order to match the engine performance characteristics to the full range of nonroad equipment.

We believe that given the timing of the emissions standards proposed today, and the availability and continuing development of technologies to address temperature management for highway engines which technologies are transferrable to all nonroad engines with greater than 25 hp power rating, that nonroad engines can be designed to meet the proposed standards in the lead time provided in this proposal.

b. Nonroad Operating Conditions and Durability

Nonroad equipment is designed to be used in a wide range of tasks in some of the harshest operating environments imaginable, from mining equipment to crop cultivation and harvesting to excavation and loading. In the normal course of equipment operation the engine and its associated hardware will experience levels of vibration, impacts, and dust that may exceed conditions typical of highway diesel vehicles.

Specific efforts to design for the nonroad operating conditions will be required in order to ensure that the benefits of these new emission control technologies are realized for the life of nonroad equipment. Much of the engineering knowledge and experience to address these issues already exists with the nonroad equipment manufacturers. Vibration and impact issues are fundamentally mechanical durability concerns (rather than issues of technical feasibility of achieving emissions reductions) for any component mounted on a piece of equipment (e.g., an engine coolant overflow tank). Equipment manufacturers must design mounting hardware such as flanges, brackets, and bolts to support the new component without failure. Further, the catalyst substrate material itself must be able to withstand the conditions encountered on nonroad equipment without itself cracking or failing. There is a large body of real world testing with retrofit emission control technologies that demonstrates the durability of the catalyst components themselves even in the harshest of nonroad equipment applications.

Deutz, a nonroad engine manufacturer, sold approximately 2,000 diesel particulate filter systems for nonroad equipment in the period from 1994 through 2000. Many of these systems were sold for use in mining equipment. No other applications are likely to be more demanding than this. Mining equipment is exposed to extraordinarily high levels of vibration, experiences impacts with the mine walls and face, and high levels of dust. Yet in meetings with the Agency, Deutz shared their experience that no system had failed due to mechanical failure of the catalyst or catalyst housing.[170] The Deutz system utilized a conventional cordierite PM filter substrate as is commonly used for heavy-duty highway truck CDPF systems. The canning and mounting of the system was a Deutz design. Deutz was able to design the catalyst housing and mounting in such a way as to protect the catalyst from the harsh environment as evidenced by its excellent record of reliable function.

Other nonroad equipment manufacturers have also offered OEM diesel particulate filter systems in order to comply with requirements of some mining and tunneling worksite standards. Liebherr, a nonroad engine and equipment manufacturer, offers diesel particulate filter systems as an OEM option on its range of construction machine models. As of January 2000, 340 Liebherr machines have been fitted with PM filter systems.[171] We believe that this experience shows that appropriate design considerations, as are necessary with any component on a piece of nonroad equipment, will be adequate to address concerns with the vibration and impact conditions which can occur in some nonroad applications. This experience applies equally well to the NOx adsorber catalyst technologies as the mechanical properties of DOCs, CDPFs, and NOx adsorbers are all similar. We do not believe that any new or fundamentally different solutions will need to be invented in order to address the vibration and impact constraints for nonroad equipment. Our cost analysis includes the hardware costs for mounting and shrouding the aftertreatment equipment as well as the engineering cost for equipment redesign.

Certain nonroad applications, including some forms of harvesting equipment and mining equipment, may have specific limits on maximum surface temperature for equipment components in order to ensure that the components do not serve as ignition sources for flammable dust particles (e.g. coal dust or fine crop dust). Some have suggested that these design constraints might limit the equipment manufacturers ability to install advanced diesel catalyst technologies such as NOx adsorbers and CDPFs. This concern seems to be largely based upon anecdotal experience with gasoline catalyst technologies where under certain circumstances catalyst temperatures can exceed 1,000˚C and without appropriate design considerations could conceivably serve as an ignition source. We do not believe that these concerns are justified in the case of either the NOx adsorber catalyst or the CDPF technology. Catalyst temperatures for NOx

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[170] “Summary of Conference Call between US EPA and Deutz Corporation on September 19, 2002 regarding Deutz Diesel Particulate Filter System”, EPA Memorandum to Air Docket A-2001-28.

[171] "Particulate Traps for Construction Machines: Properties and Field Experience” J. Czerwinski et. al., Society of Automotive Engineers Technical Paper 2000-01-1923.

adsorbers and CDPFs should not exceed the maximum exhaust manifold temperatures already commonly experienced by diesel engines (i.e, catalyst temperatures are expected to be below 800˚C).[172] CDPF temperatures are not expected to exceed approximately 700˚C in normal use and are expected to only reach the 650˚C temperature during periods of active regeneration. Similarly, NOx adsorber catalyst temperatures are not expected to exceed 700˚C and again only during periods of active sulfur regeneration as described in Section III.F below. Under conditions where diesel exhaust temperatures are naturally as high as 650˚C, no supplemental heat addition from the emission control system will be necessary and therefore exhaust temperatures will not exceed their natural level. When natural exhaust temperatures are too low for effective emission system function then supplemental heating as described earlier may be necessary but would not be expected to produce temperatures higher than the maximum levels normally encountered in diesel exhaust. Furthermore, even if it were necessary to raise exhaust temperatures to a higher level in order to promote effective emission control, there are technologies available to isolate the higher exhaust temperatures from flammable materials such as dust. One approach would be the use of air-gapped exhaust systems (i.e., an exhaust pipe inside another concentric exhaust pipe separated by an air-gap) that serve to insulate the inner high temperature surface from the outer surface which could come into contact with the dust. The use of such a system may be additionally desirable in order to maintain higher exhaust temperatures inside the catalyst in order to promote better catalyst function. Another technology to control surface temperature already used by some nonroad equipment manufacturers is water cooled exhaust systems.[173] This approach is similar to the air-gapped system but uses engine coolant water to actively cool the exhaust system. We do not believe that flammable dust concerns will prevent the use of either a NOx adsorber or a CDPF because catalyst temperatures are not expected to be unacceptably high and because remediation technologies exist to address these concerns. In fact, exhaust emission control technologies (i.e., aftertreatment) have already been applied on both an OEM basis and for retrofit to nonroad equipment for use in potentially explosive environments. Many of these applications must undergo Underwriters Laboratory (UL) approval before they can be used.[174]

Nonroad engines greater than 750 hp are unique in that they do not have direct highway equivalents. However, this does not mean that unique catalyst based emission control technologies need to be developed separately for these larger applications. Rather, larger engines can, and do in retrofit applications today, use multiple catalyst systems in a parallel configuration.

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172 The hottest surface on a diesel engine is typically the exhaust manifold which connects the engines exhaust ports to the inlet of the turbocharger. The hot exhaust gases leave the engine at a very high temperature (800˚C at high power conditions) and then pass through the turbocharger where the gases expand driving the turbocharger providing work. The process of extracting work from the hot gases cools the exhaust gases. The exhaust leaving the turbocharger and entering the catalyst and the remaining pieces of the exhaust system is cooler (as much as 200˚C at very high loads) than in the exhaust manifold.

173 "Engine Technology and Application Aspects for Earthmoving Machines and Mobile Cranes, Dr. E. Brucker, Liebherr Machines Bulle, SA, AVL International Commercial Powertrain Conference, October 2001. Copy available in EPA Air Docket A-2001-28, Docket Item # II-A-12.

174 Phone conversation with Manufacturers of Emission Control Association (MECA), 9 April, 2003 confirming the use of emission control technologies on nonroad equipment used in coal mines, refineries, and other locations where explosion proofing may be required.

As an example, a highway 12 liter displacement in-line six cylinder engine might use a single 18 liter CDPF, while a nonroad 24 liter displacement V12 cylinder (a vee engine has two rows of cylinders set at an angle to each other) engine would use two 18 liter CDPFs, one for each bank of the vee engine. Using two smaller catalysts in place of one larger catalyst can be easier to package and may allow for close coupling of the catalyst technology to the turbocharger exhaust outlet to improve temperature management in some applications. Today, many passenger cars and light-duty trucks with V6 or V8 engines use individual catalysts for each engine bank to improve packaging and better manage temperatures.

We agree that nonroad equipment must be designed to address durable performance for a wide range of operating conditions and applications that would not commonly be experienced by highway vehicles. We believe further as demonstrated by retrofit experiences around the world that technical solutions exist which allow catalyst-based emission control technologies to be applied to nonroad equipment.

3. Are the Standards Proposed for Engines of 75 hp or Higher Feasible?

There are three primary test provisions and associated standards in the Tier 4 program we are proposing today. These are the proposed Nonroad Transient Cycle (NRTC), the existing ISO C1 steady-state cycle, and the proposed highway based Not-To-Exceed (NTE) provisions. A nonroad diesel engine meeting the proposed standards for each of these three test cycles would be lawful for use in any kind of nonroad equipment. Additionally, we have alternative optional test cycles including the proposed Constant Speed Variable Load (CSVL) cycle, the existing ISO-D2 steady-state cycle and the proposed Transportation Refrigeration Unit (TRU) cycle which a manufacturer can choose to use for certification provided that the manufacturer can demonstrate to the Agency that the engine will only be used in a limited range of nonroad equipment with specifically defined operating conditions. Compliance on the proposed transient test cycles includes weighting the results from a cold start and hot start test with the cold start emissions weighted at 1/10 and hot start emissions weighted at 9/10. A complete discussion of these various test cycles can be found in Chapter 4.2 and 4.3 of the draft RIA.

The standards proposed today for nonroad engines with rated power greater than or equal to 75 horsepower are based upon the technologies and standards for highway diesel engines which go into effect in 2007. As explained above, we believe these technologies, namely NOx adsorbers and catalyzed diesel particulate filters enabled by 15 ppm sulfur diesel fuel, can be applied to nonroad diesel engines in a similar manner as for highway diesel engines. We acknowledge that there are additional constraints on nonroad diesel engines which must be considered in setting these standards, and we have addressed those issues by allowing for additional lead time or slightly less stringent standards for nonroad diesel engines in comparison to highway diesel engines (and likewise have made appropriate cost estimates to account for the technology and engineering needed to address these constraints).

We have proposed a PM standard for engines in this category of 0.01 g/bhp-hr based upon the emissions reductions possible through the application of a CDPF and 15ppm sulfur diesel fuel.

This is the same emissions level as for highway diesel engines in the HD2007 program. While baseline soot (the solid carbon fraction of PM) emission levels may be somewhat higher for some nonroad engines when compared to highway engines, these emissions are virtually eliminated (reduced by 99 percent) by the CDPF technology. As discussed previously, the baseline (engine-out) SOF emissions levels may also need to be reduced through the application of modern piston ring pack designs and valve stem seals. With application of the CDPF technology, the SOF portion of diesel PM is predicted to be all but eliminated. The primary emissions from a CDPF equipped engine are sulfate PM emissions formed from sulfur in diesel fuel. The emissions rate for sulfate PM is determined primarily by the sulfur level of the diesel fuel and the rate of fuel consumption. With the 15 ppm sulfur diesel fuel the PM emissions level from a CDPF equipped nonroad diesel engine will be similar to the emissions rate of a comparable highway diesel engine. Therefore, the 0.01 g/bhp-hr emission level is feasible for nonroad engines tested on the NRTC cycle and on the steady-state cycles, C1 and D2. Put another way, control of PM using CDPF technology is essentially independent of duty cycle given active catalyst technology (for reliable regeneration and SOF oxidation), adequate control of temperature (for reliable regeneration) and low sulfur diesel fuel (for reliable regeneration and low PM emissions).

The most challenging PM emissions control conditions for a CDPF are encountered under high engine load operation where high exhaust temperatures promote conversion of sulfur in diesel fuel to sulfate PM emissions. Under these high load conditions, soot and SOF oxidation rates will be very high and control of those portions of PM emissions will be highly effective. Sulfate PM emissions, however, will be higher than for other operating conditions. In a worst case scenario, where all of the sulfur is converted to sulfate, it could be perhaps as high as 0.02 g/bhp-hr.[175] This level of PM emissions would comply with our proposed NTE provisions once consideration is given to the 1.5 times multiplier on the emission standard for NTE test conditions.[176] Since this estimate is made at a worst case condition (assuming 100% conversion of sulfur to sulfate), we feel confident that the PM NTE provisions of this proposal can be met.

Under contract from the California Air Resources Board, two nonroad diesel engines were recently tested for PM emissions performance with the application of a CDPF over a number of transient and steady-state test cycles.[177] The first engine is a 1999 Caterpillar 3408 (480 hp, 18 liter displacement) nonroad diesel engine certified to the Tier 1 standards. The engine was tested with and without a CDPF on 12 ppm sulfur diesel fuel. The transient emission results for this engine are summarized in Table III.E-1 below. The steady-state emission results are summarized in Table III.1-2. The test results confirm the excellent PM control performance realized by a

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175 An estimate of the maximum sulfate PM emissions rate can be made by assuming a fuel consumption rate (e.g., 0.5 lbm/bhp-hr), the fuel sulfur level (e.g., 15 ppm) and the sulfur to sulfate conversion (e.g., 100% maximum) resulting in a calculated sulfate PM emissions rate of 0.02 g/bhp-hr. This represents a worst case analysis (100% sulfur conversion with 15 ppm sulfur fuel). In-use emissions would be significantly lower.

176 The PM standard is expressed to two significant digits 0.01 g/bhp-hr, so when the 1.5 NTE multiplier is applied, the NTE limit becomes 0.015 which is rounded to two significant figures as 0.02 g/bhp-hr.

177 Application of Diesel Particulate Filters to Three Nonroad Engines - Interim Report, January 2003. Copy available in EPA Air Docket A-2001-28.

CDPF with low sulfur diesel fuel across a wide range of nonroad operating cycles in spite of the relatively high engine-out PM emissions from this Tier 1 engine. We would expect engine-out PM emissions to be lower for production Tier 3 compliant diesel engines that will form the technology baseline for Tier 4 engines meeting the proposed standard. The engine demonstrated PM emissions of 0.009 g/bhp-hr on the proposed Nonroad Transient Cycle (NRTC) from an engine-out level of 0.256 g/bhp-hr, a reduction of 0.247 g/bhp-hr. The engine also demonstrated excellent PM performance on the existing steady-state ISO C1 cycle with PM emissions of 0.010 g/bhp-hr from an engine-out level of 0.127, a reduction of 0.107 g/bhp-hr. Thus this engine would be compliant with the proposed PM emission standard for ≥75 hp variable speed nonroad engines.

When tested on the proposed optional constant speed variable load cycle (CSVL) (a test to which this engine would not be subject to under this proposal) the engine-out PM emission levels were 0.407 g/bhp-hr and were reduced to 0.016 g/bhp-hr (a reduction of 0.391 g/bhp-hr) with the addition of the PM filter. As tested this engine would not be compliant with the proposed optional CSVL standard, but this is not surprising given that this Tier 1 engine was designed for variable speed engine operation and not for single speed operation. We have great confidence given the substantial PM reduction realized in this testing over the proposed CSVL cycle with a CDPF that a properly designed nonroad diesel engine will be able to meet the standard of 0.01 g/bhp-hr.

TABLE III.E-1 -- TRANSIENT PM EMISSIONS FOR A TIER 1 NR DIESEL ENGINE WITH A CDPF

1999 (Tier 1) Caterpillar 3408 (480hp, 18l)

	PM [g/bhp-hr]		Reduction
Test Cycle	Engine Out	w/ CDPF	%
Proposed Nonroad TransientCycle (NRTC)	0.256	0.009	96%
Proposed Constant Speed Variable Load Cycle (CSVL)	0.407	0.016	96%
On-Highway U.S. FTP Transient Cycle (FTP)	0.239	0.019	92%
Agricultural Tractor Cycle (AGT)	0.181	0.009	95%
Backhoe Loader Cycle (BHL)	0.372	0.022	94%
Crawler Tractor Dozer Cycle (CRT)	0.160	0.014	91%
Composite Excavator Duty Cycle (CEX)	0.079	0.009	88%
Skid Steer Loader Typical No. 1 (SST)	0.307	0.016	95%
Skid Steer Loader Typical No. 2 (SS2)	0.242	0.013	95%
Skid Steer Loader Highly Transient Speed (SSS)	0.242	0.008	97%
Skid Steer Loader Highly Transient Torque (SSQ)	0.351	0.004	99%
Arc Welder Typical No.1 (AWT)	0.510	0.018	96%
Arc Welder Typical No.2 (AW2)	0.589	0.031	95%
Arc Welder Highly Transient Speed (AWS)	0.424	0.019	96%
Rubber-Tired Loader Typical No.1 (RTL)	0.233	0.010	96%
Rubber-Tired Loader Typical No.2 (RT2)	0.236	0.011	96%
Rubber-Tired Loader Highly Transient Speed (RTS)	0.255	0.008	97%
Rubber-Tired Loader Highly Transient Torque (RTQ)	0.294	0.009	97%

Table III.E-1 also shows results over a large number of additional test cycles developed from real world in-use test data to represent typical operating cycles for different nonroad equipment applications (see Chapter 4.2 of the draft RIA for information on these test cycles). These test cycles are not used for regulatory purposes, although the information from these cycles was used in developing the proposed NRTC. The results show that the CDPF technology is highly effective to control in-use PM emissions over any number of disparate operating conditions. Remembering that the base Tier 1 engine was not designed to meet a transient PM standard, the CDPF emissions demonstrated here show that very low emission levels are possible even when engine-out emissions are exceedingly high (e.g., a reduction of 0.558 g/bhp-hr is demonstrated on the AW2 cycle).

The results summarized in the two tables are also indicative of the feasibility of the proposed NTE provisions of this rulemaking. In spite of the Tier 1 baseline of this engine, there are only three test results with emissions higher than the permissible limit for the proposed NTE. The first in Table III.E-1 shows PM emissions of 0.031 over the AW2 cycle but from a very high baseline level of nearly 0.6 g/bhp-hr. We believe that simple improvements to the engine-out PM emissions as needed to comply with the Tier 2 emission standard would reduce these emission below the 0.02 level required by the standard. There are two other test points in Table III.E-2 which are above the proposed NTE emission level, both at 10 percent engine load. However, both are outside the NTE zone which excludes emissions for engine loads below 30 percent. It is important to note that although the engine would not be constrained to meet the NTE under these conditions, the resulting reductions at both points are still substantial in excess of 96 percent.

TABLE III.E-2 -- STEADY-STATE PM EMISSIONS FROM A TIER 1 NR DIESEL ENGINE W/ CDPF

1999 (Tier 1) Caterpillar 3408 (480hp, 18l)				
Engine Speed	Engine Load	PM ([g/bhp-hr]		Reduction
%	%	Engine Out	w/ CDPF	%
100	100	0.059	0.010	83%
100	75	0.103	0.009	91%
100	50	0.247	0.012	95%
100	25	0.247	0.000	100%
100	10	0.925	0.031	97%
60	100	0.028	0.011	61%
60	75	0.138	0.009	93%
60	50	0.180	0.010	95%
60	25	0.370	0.007	98%
60	10	0.801	0.018	98%
91	82	0.091	0.006	93%
80	63	0.195	0.008	96%
63	40	0.240	0.008	97%
0	0	--	--	--
	ISO C1 Composite	0.127	0.011	91%

The second engine tested was a prototype engine developed at Southwest Research Institute (SwRI) under contract to EPA.[178] The engine, dubbed Deere Development Engine 4045

[178] "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

(DDE-4045) because the prototype engine was based on a John Deere 4045 production engine, was also tested with a CDPF from a different manufacturer on the same 12 ppm diesel fuel. The engine is very much a prototype and experienced a number of part failures during testing, including to the turbocharger actuator. Nevertheless, the transient emission results summarized in Table III.E-3 and the steady-state results summarized in Table III.E-4 show that substantial PM reductions are realized on this engine as well. The emission levels on the NRTC and the ISO C1 cycle would be compliant with the proposed PM standard of 0.01 g/bhp-hr once the appropriate rounding convention was applied.[179] It is also interesting to note that the highway FTP transient emissions are higher than for either of the proposed nonroad transient tests. This suggests that developing PM compliant engines on the proposed nonroad transient cycles may not be substantially different from developing compliant technologies for highway engines. Our analysis of exhaust temperature characteristics for NOx adsorber catalysts discussed in the preceding section, noted a similar trend for NOx technologies (i.e., that the exhaust temperature characteristics of the NRTC may be better matched catalyst technologies than the HD FTP).

TABLE III.E-3 -- TRANSIENT PM EMISSIONS FOR A PROTOTYPE NR DIESEL ENGINE WITH A CDPF

EPA Prototype Tier 3 DDE-4045 (108hp, 4.5l)

	PM [g/bhp-hr]		Reduction
Test Cycle	Engine Out	w/ CDPF	%
Proposed Nonroad TransientCycle (NRTC)	0.143	0.013	91%
Proposed Constant Speed Variable Load Cycle (CSVL)	0.218	0.018	92%
On-Highway U.S. FTP Transient Cycle (FTP)	0.185	0.023	88%
Agricultural Tractor Cycle (AGT)	0.134	0.008	94%
Backhoe Loader Cycle (BHL)	0.396	0.021	95%
Crawler Tractor Dozer Cycle (CRT)	0.314	0.008	97%
Composite Excavator Duty Cycle (CEX)	0.176	0.009	95%
Skid Steer Loader Typical No. 1 (SST)	0.288	0.012	96%
Skid Steer Loader Typical No. 2 (SS2)	0.641	0.013	98%
Skid Steer Loader Highly Transient Speed (SSS)	0.298	0.011	96%
Skid Steer Loader Highly Transient Torque (SSQ)	0.536	0.014	97%
Arc Welder Typical No.1 (AWT)	0.290	0.018	94%
Arc Welder Typical No.2 (AW2)	0.349	0.019	95%
Arc Welder Highly Transient Speed (AWS)	0.274	0.019	93%
Rubber-Tired Loader Typical No.1 (RTL)	0.761	0.014	98%
Rubber-Tired Loader Typical No.2 (RT2)	0.603	0.012	98%
Rubber-Tired Loader Highly Transient Speed (RTS)	0.721	0.010	99%
Rubber-Tired Loader Highly Transient Torque (RTQ)	0.725	0.009	99%

As with the results from the Caterpillar engine, the two low-load (10 percent load) steady-state emissions points have some of the highest brake specific emission rates. These rates are not high enough, however, to preclude compliance with the steady-state emission cycle, are not within the proposed NTE zone, and still show substantial PM reduction levels.

[179] The rounding procedures in ASTM E29-90 are applied to the emission standard, therefore, the emission results are rounded to the same number of significant digits as the specified standard, i.e., 0.014 g/bhp-hr is rounded to 0.01 g/bhp-hr, while 0.015 g/bhp-hr would be rounded to 0.02 g/bhp-hr.

TABLE III.E-4 -- STEADY-STATE PM EMISSIONS FOR A PROTOTYPE NR DIESEL ENGINE W/CDPF

EPA Prototype Tier 3 DDE-4045 (108hp, 4.5l)				
Engine Speed	Engine Load	PM [g/bhp-hr]		Reduction
%	%	Engine Out	w/ CDPF	%
100	100	0.178	0.012	93%
100	75	0.116	0.006	95%
100	50	0.126	0.006	96%
100	25	0.218	0.013	94%
100	10	0.470	0.029	94%
60	100	0.045	0.007	84%
60	75	0.062	0.014	78%
60	50	0.090	0.009	90%
60	25	0.146	0.019	87%
60	10	0.258	0.046	82%
91	82	0.094	0.004	95%
80	63	0.099	0.006	94%
63	40	0.136	0.011	92%
0	0	--	--	--
	ISO C1 Composite	0.129	0.010	92%

While the resulting PM emission levels for nonroad diesel engines are similar to the levels for highway diesel engines, the challenge of ensuring soot regeneration of the CDPF may be more difficult for some nonroad equipment types. As explained earlier, effective regeneration occurs when the aggregate soot rate into the CDPF over an extended period is less than or equal to the soot oxidation rate over the same period. Because the baseline PM soot rate into the CDPF level may be higher for some nonroad engines and because the average exhaust temperature may be lower for some operating cycles, additional engine and aftertreatment system development will be needed for some nonroad engines. These additional developments include improved thermal management and improved active back-up systems which can periodically raise exhaust temperatures in order to initiate regeneration. We expect these systems to be evolutionary advancements based primarily on the core technologies used by nonroad manufacturers to comply with the Tier 3 emission standards with enhancements from the highway technologies developed to comply with the HD2007 standards. The implementation dates for the standards proposed today were selected in part based upon the time we believe will be necessary to transfer and further develop these highway technologies to nonroad diesel engines and equipment.

We are proposing a NOx standard of 0.3 g/bhp-hr for engines in this category based upon the emission reductions possible from the application of NOx adsorber catalysts and the expected emission levels for Tier 3 compliant engines which form the baseline technology for Tier 4 engines. The Tier 3 emission standards are a combined NOx+NMHC standard of 3.0 g/bhp-hr for engines greater than 100 hp and less than 750 horsepower. For engines less than 100 hp but greater than 50 horsepower the Tier 3 NOx+NMHC emission standard is 3.5 g/bhp-hr. For engines greater than 750 horsepower there is no Tier 3 NOx+NMHC standard. We believe that in the time-frame of the Tier 4 emission standards proposed today, all engines of 75 horsepower or higher can be developed to control NOx emissions to engine-out levels of 3.0 g/bhp-hr or lower. This means that all engines will need to apply Tier 3 emission control technologies (i.e., turbochargers, charge-air-coolers, electronic fuel systems, and for some manufacturers EGR systems) to get to this baseline level, even those engines without a Tier 3 standard (i.e., >750hp engines). As discussed in more detail in the draft RIA, our analysis of the NRTC and the ISO C1 cycles indicates that the NOx adsorber catalyst can provide a 90 percent or greater NOx reduction level on the cycles. The proposed standard of 0.3 g/bhp-hr reflects a baseline emissions level of 3.0 g/bhp-hr and a 90 percent or greater reduction of NOx emissions through the application of the NOx adsorber catalyst. The additional lead time available to nonroad engine manufacturers and the substantial learning that will be realized from the introduction of these same technologies to highway diesel engines, plus the lack of any fundamental technical impediment, makes us confident that the proposed NOx standards can be met.

The proposed standard is 50 percent higher than the corresponding HD2007 standard of 0.2 g/bhp-hr because of the higher baseline NOx emissions for Tier 3 engines. The higher baseline (engine-out) NOx level is due primarily to a lack of ram-air for improved charge-air cooling for nonroad diesel engines when compared to highway diesel engines compliant with the 2004 highway emission standards. Although nonroad engine manufacturers may be able to lower engine-out NOx emissions below the levels required for Tier 3, we continue to expect that the lack of ram air will limit nonroad engine-out NOx performance, and therefore we have accounted for that difference by proposing this higher NOx emissions level.

We believe that the NOx adsorber technology developed for highway engines can be applied with equal effectiveness to nonroad diesel engines with additional developments in engine thermal management (as discussed in Section III.E.2 above) to address the more widely varied nonroad operating cycles. In fact, as discussed previously, the NOx adsorber catalyst temperature window is particularly well matched to transient operating conditions as typified by the NRTC.

Compliance with the NTE provisions proposed today will be challenging for the nonroad engine industry due to the diversity of nonroad products and operating cycles. However, the technical challenge is reduced somewhat by the 1.5 multiplier used to calculate the NTE standard. Controlling NOx emissions under NTE conditions is fundamentally similar for both highway and nonroad engines. The range of control is the same and the amount of reduction required is also the same. We know of no technical impediment that would prevent achieving the NTE standard under the full range of operating conditions.

The proposed NOx standard is phased in over a number of years in a manner similar to the HD2007 NOx phase-in. In the early years of the program half of the engines produced by a manufacturer must be certified to the new emission standard while the remaining engines can continue to be sold at the previous standard. We provided this phase-in period for highway engines in the HD2007 rulemaking to allow manufacturers to focus resources on the portion of their products best suited to NOx catalysts first and then to apply the learning to the remainder of their products three years later.[180] Provisions of the averaging program in the HD2007 rulemaking allow manufacturers to alternatively comply with some engine families at an "averaged" standard that is approximately halfway between the old and new NOx standards. In fact, we have learned

[180] Control of Air Pollution from New Motor Vehicles: Heavy-duty Engine and Vehicle Standards and Highway Diesel Sulfur Control Requirements; Final Rule, 66 FR 5002, January 18, 2001.

from a number of engine manufacturers that they are likely to employ this strategy for some fraction of their new highway engines in 2007. The averaging provisions that we have proposed today for Tier 4 would also allow for compliance with the proposed Tier 4 NOx standard with a single engine product during the transitional NOx phase-in period. This provision allows manufacturers to transfer the same highway NOx technologies to nonroad engines and to comply with an appropriately stringent standard. We believe as with the HD2007 rule that this provision is necessary in order to manage resource requirements to develop the necessary technologies and that this provision provides significant additional flexibility for manufacturers to comply with the proposed NOx standards. Similarly, we have proposed a modified phase-in schedule for the greater than 750 horsepower engines in part because of the lack of a Tier 3 standard for those engine and the extra work required to develop a full Tier 4 emission control system from a Tier 2 baseline.

Meeting the proposed NMHC standard under the lean operating conditions typical of the biggest portion of NOx adsorber operation should not present any special challenges to nonroad diesel engine manufacturers. Since CDPFs and NOx adsorbers contain platinum and other precious metals to oxidize NO to NO_2, they are also very efficient oxidizers of hydrocarbons. NMHC reductions of greater than 95 percent have been shown over transient and steady-state test procedures.[181] Given that typical engine-out NMHC is expected to be in the 0.40 g/bhp-hr range or lower for engines meeting the Tier 3 standards, this level of NMHC reduction will mean that under lean conditions emission levels will be well below the standard.

The NOx regeneration strategies for the NOx adsorber technology may prove difficult to control precisely, leading to a possible increase in NMHC emissions under the rich operating conditions required for NOx regeneration. Even with precise control of the regeneration cycle, NMHC slip may prove to be a difficult problem due to the need to regenerate the NOx adsorber under net rich conditions (excess fuel) rather than the stoichiometric (fuel and air precisely balanced) operating conditions typical of a gasoline three-way catalyst. It seems possible therefore, that in order to meet the NMHC standards we have proposed, an additional clean up catalyst may be required. A diesel oxidation catalyst, like those applied historically for NMHC and partial PM control, can reduce NMHC emissions (including toxic HCs) by more than 90 percent.[182] This amount of additional control along with optimized NOx regeneration strategies will ensure very low NMHC emissions. Our cost analysis described in Section V includes the cost for the application of a clean-up DOC catalyst for all engines which must comply with the 0.3 g/bhp-hr NOx standard.

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181 "The Impact of Sulfur in Diesel Fuel on Catalyst Emission Control Technology," report by the Manufacturers of Emission Controls Association, March 15, 1999, pp. 9 & 11. Copy available in EPA Air Docket A-2001-28.

182 "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels", Manufacturers of Emissions Controls Association, June 1999. Copy available in EPA Air Docket A-2001-28.

Test results from a prototype integrated NOx/PM and NMHC control system for diesel engines documented in the draft RIA show that NMHC emissions can be controlled below 0.14 g/bhp-hr under transient and steady-state test conditions for highway diesel engines while simultaneously controlling NOx emissions below 0.2 g/bhp-hr and PM emissions below 0.01 g/bhp-hr. Since the slip of hydrocarbon emissions are predominantly a function of the NOx regeneration event and not engine transient events, the level of control demonstrated in this testing is expected to be the same for other operating conditions as represented by the proposed NRTC cycle and the NTE provisions of this rulemaking. Based on our engineering judgement and experience testing integrated NOx adsorber and PM filter systems with DOC clean-up catalyst technologies, we can conclude that the 0.14 g/bhp-hr NMHC standard will be feasible in the Tier 4 time frame.

The proposed standards include a cold start provision with the transient test procedures. This means that the results of a cold start transient test will be weighted with the emissions of a hot start test in order to calculate the emissions for compliance against the proposed standards. The proposed weightings are 1/10 cold start and 9/10 for the hot start as described more fully in chapter 4.2 of the draft RIA. Because exhaust temperatures are so important to catalyst performance the cold start provision is an important tool to ensure that the emissions realized in use are consistent with the expectations of this program and represents an additional technical challenge for NOx control and to a lesser extent CO and NMHC control. PM control with a CDPF is not expected to be significantly impacted by cold-start provisions. NOx control in the period before temperatures exceed the catalyst light-off temperature are reduced significantly. As a result, exhaust stack NOx emissions will be higher over the cold start portion of the test. However, we believe that this increase in NOx emissions will not be high enough to preclude compliance with the proposed NOx standard once the 1/10 weighting is applied.

There are number of technologies available to the engine manufacturer to promote rapid warmup of the exhaust and emission control system. These include retarding injection timing, increasing EGR, and potentially late cycle injection all of which are technologies we expect manufacturers to apply as part of the normal operation of the NOx adsorber catalyst system. These are the same technologies we expect highway engine manufacturers to use in order to comply with the highway cold start FTP provision which weights cold start emissions more heavily with a 1/7 weighting. As a result, we expect the transfer of highway technology to be well matched to accomplish this control need for nonroad engines as well. Using these technologies we expect nonroad engine manufacturers to be able to comply with the proposed NOx, NMHC and CO emissions including the cold start provisions of the transient test procedure.

We did not set new Tier 3 emission standards for >750 hp nonroad engines in the 1998 Tier 2/3 rulemaking because of the long lead time we believed appropriate, given the long product redesign cycles typical of these large engines and their low sales volumes. The Tier 2 standards set in that rulemaking for >750 hp engines do not go into effect until 2006. We reasoned in the Tier 2/3 rule that the uncertainties involved in setting a Tier 3 standard for >750hp nonroad engines that wouldn't go into effect before 2010 would be too large. Therefore, we deferred setting new standards for these engines at that time. Given new technology enabled by low sulfur diesel fuel, we believe that it is now appropriate to project the technologies which will be available for these engines in the future (i.e., CDPFs and NOx adsorbers) and to set new standards accordingly.

Although we have proposed a unique phase-in schedule for >750hp engines as explained in explained in Section III.B, we do not doubt that these engines, like engines <750hp, can be developed to meet the standards proposed today. These large engines are fundamentally similar to other nonroad engines. The project emissions control mechanisms are the same. Retrofits of PM filter systems have been applied to large locomotives and other similar size engines. We are unaware of any fundamental difference in technology function that would lead us to conclude that the proposed standards are inappropriate for engines >750hp. However, given the need to apply both new engine-out control technologies (i.e., Tier 3 type technologies) in addition to the new catalyst based technologies in order to comply with the proposed standards, and given the low sales volumes for these engines, we do believe it is appropriate to have a different phase-in structure for these engines. We invite comment supported by data on this issue, particularly if a commenter believes there are fundamental technology differences which would make alternate standards more appropriate for >750hp nonroad engines.

The standards that we have proposed today for nonroad engines with rated horsepower levels ≥75 horsepower are based upon the same emission control technologies, clean 15ppm or lower sulfur diesel fuel, and relative levels of emission control effectiveness as the HD 2007 emission standards. We have given consideration to the diversity of nonroad equipment for which these technologies must be developed and the timing of the Tier 3 emissions standards in determining the appropriate timing for the Tier 4 standards we have proposed today. Based upon the availability of the emission control technologies, the proven effectiveness of the technologies to control diesel emissions to these levels, the technology paths identified here to address constraints specific to nonroad equipment, and the additional lead time afforded by the timing of the standards, we have concluded that the proposed standards are feasible.

4. Are the Standards Proposed for Engines ≥25 hp and <75 hp Feasible?

As discussed in Section III.B, our proposal for standards for engines between 25 and 75 hp consists of a 2008 transitional standard and long-term 2013 standards. The proposed transitional standard is a 0.22 g/bhp-hr PM standard. The 2013 standards consist of a 0.02 g/bhp-hr PM standard and a 3.5 g/bhp-hr NMHC+NOx standard. As discussed in Section III.B, the transitional standard is optional for 50-75 hp engines, as the proposed 2008 implementation date is the same as the effective date of the Tier 3 standards. Manufacturers may decide, at their option, not to undertake the 2008 transitional PM standard, in which case their implementation date for the 0.02 g/bhp-hr PM standard begins in 2012.

In addition, we have proposed a minor revision to the CO standard for the 25-50 hp engines beginning in 2008 to align these engines with the 50-75 hp engines. This proposed CO standard is 3.7 g/bhp-hr.

The remainder of this section discusses:

- what makes the 25-75 hp category unique;
- what engine technology is used today, and will be used for applicable Tier 2 and Tier 3 standards;
- why the proposed standards are technologically feasible; and,
- why EPA has not proposed more stringent NOx standards at this time for these engines.

a. What makes the 25 - 75 hp category unique?

As discussed in Section III.B.1.d, many of the nonroad diesel engines ≥75 hp are either a direct derivative of highway heavy-duty diesel engines, or share a number of common traits with highway diesel engines. These include similarities in displacement, aspiration, fuel systems, and electronic controls. Table III.E-3 contains a summary of a number of key engine parameters from the 2001 engines certified for sale in the U.S.[183]

TABLE III.E-3: SUMMARY OF MODEL YEAR 2001 KEY ENGINE PARAMETERS BY POWER CATEGORY

Engine Parameter	Percent of 2001 U.S. Production[a]			
	0-25 hp	25-75 hp	75-100 hp	>100 hp
IDI Fuel System	83%	47%	4%	<0.1%
DI Fuel System	17%	53%	96%	>99%
Turbocharged	0%	7%	62%	91%
1 or 2 Cylinder Engines	47%	3%	0%	0%
Electronic fuel systems (estimated)	not available today	limited availability today	available today	commonly available today

Notes:
[a] Based on sales weighting of 2001 engine certification data.

As can be seen in Table III.E-3, the engines in the 25-75 hp category have a number of technology differences from the larger engines. These include a higher percentage of indirect-injection fuel systems, and a low fraction of turbocharged engines. (The distinction in the <25 hp category is quite different, with no turbocharged engines, nearly one-half of the engines have two cylinders or less, and a significant majority of the engines have indirect-injection fuel systems.)

The distinction is particularly marked with respect to electronically controlled fuel systems. These are commonly available in the ≥ 75 hp power categories, but, based on the available certification data as well as our discussions with engine manufacturers, we believe there

[183] Data in Table III.E-3 is derived from a combination of the publically available certification data for model year 2001 engines, as well as the manufacturers reported estimates of 2001 production targets, which is not public information.

are very limited numbers, if any, in the 25-75 hp category (and no electronic fuel systems in the less than 25 hp category). The research and development work being performed today for the heavy-duty highway market is targeted at engines which are 4-cylinders or more, direct-injection, electronically controlled, turbocharged, and with per-cylinder displacements greater than 0.5 liters. As discussed in more detail below, as well as in Section III.E.5 (regarding the <25 hp category), these engine distinctions are important from a technology perspective and warrant a different set of standards for the 25-75 hp category (as well as for the <25 hp category).

b. What engine technology is used today, and will be used for the applicable Tier 2 and Tier 3 standards?

In the 1998 nonroad diesel rulemaking, we established Tier 1 and Tier 2 standards for engines in the 25-50 hp category. Tier 1 standards were implemented in 1999, and the Tier 2 standards take effect in 2004. The 1998 rule also established Tier 2 and Tier 3 standards for engines between 50 and 75 hp. The Tier 2 standards take effect in 2004, and the Tier 3 standards take effect in 2008. The Tier 1 standards for engines between 50 and 75 hp took effect in 1998. Therefore, all engines in the 25-75 hp range have been meeting Tier 1 standards for the past several years, and the data presented in Table III.E-3 represent performance of Tier 1 technology for this power range.

As discussed in Section III.E.4.a, engines in the 25-75 hp category use either indirect injection (IDI) or direct injection (DI) fuel systems. The IDI system injects fuel into a pre-chamber rather than directly into the combustion chamber as in the DI system.[184] This difference in fuel systems results in substantially different emission characteristics, as well as differences in several important operating parameters. In general, the IDI engine has lower engine-out PM and NOx emissions, while the DI engine has better fuel efficiency and lower heat rejection.[185]

We expect a significant shift in the engine technology which will be used in this power category as a result of the upcoming Tier 2 and Tier 3 standards, in particular for the 50-75 hp engines. In the 50-75 hp category, the 2008 Tier 3 standards will likely result in the significant use of turbocharging and electronic fuel systems, as well as the introduction of both cooled and uncooled exhaust gas recirculation by some engine manufacturers and possibly the use of charge-air-cooling.[186] In addition, we have heard from some engine manufactures that the engine technology used to meet Tier 3 for engines in the 50-75 hp range will also be made available on those engines in the 25-50 hp range which are built on the same engine platform. For the Tier 2 standards for the 25-50 hp products, a large number of engines meet these standards today, and

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[184] See for example "Diesel-engine Management" published by Robert Bosch GmbH, 1999, second edition, pages 6-8 for a more detailed discussion of the differences between and IDI and DI engines.

[185] See Chapter 14, section 4 of "Turbocharging the Internal Combustion Engine, N. Watson and M.S. Janota, published by John Wiley and Sons, 1982.

[186] See Section 2.2 through 2.3 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

therefore we expect to see only moderate changes in these engines, including the potential additional use of turbocharging on some models.[187]

c. Are the proposed standards for 25 - 75 hp engines technologically feasible?

This section will discuss the technical feasibility of both the proposed 2008 PM standard and the 2013 standards. For an explanation and discussion of the proposed implementation dates, please refer to Section III.B of this this proposal.

i. 2008 PM Standards[188]

As just discussed in Section III.E.4.b, engines in the 25-50 hp category must meet Tier 1 NMHC+NOx and PM standards today. We have examined the model year 2002 engine certification data for engines in the 25-50 hp category. These data indicate that over 10 percent of the engine families meet the proposed 2008 0.22 g/bhp-hr PM standard and 5.6 g/bhp-hr NMHC+NOx standard (unchanged from Tier 2 in 2008) today. These include a variety of engine families using a mix of engine technologies (IDI and DI, turbocharged and naturally aspirated) tested on a variety of certification test cycles.[189] Five engine families are more than 20 percent below the proposed 0.22 g/bhp-hr PM standard, and an additional 24 engine families are within 30 percent of the proposed 2008 PM standards while meeting the NMHC+NOx standard. A detailed discussion of these data is contained in the draft RIA. Unfortunately, similar data do not exist for engines between 50 and 75 hp. There is no Tier 1 PM standard for engines in this power range, and therefore engine manufacturers are not required to report PM emission levels until Tier 2 starts in 2004. However, in general, the 50-75 hp engines are more technologically advanced than the smaller horsepower engines and would be expected to perform as well as, if not better than, the engines in the 25 - 50 hp range.

The model year 2002 engines in this power range use well known engine-out emission control technologies, such as optimized combustion chamber design and fuel injection timing control strategies, to comply with the existing standards. These data have a two-fold significance. First, they indicate that a number of engines in this power range can already achieve the proposed 2008 standard for PM using only engine-out technology, and that other engines should be able to achieve the standard making improvements just to engine-out performance. Despite being certified to the same emission standards with similar engine technology, the emission levels from these engines vary widely. Figure III.E-1 is a graph of the model year 2002 HC+NOx and PM

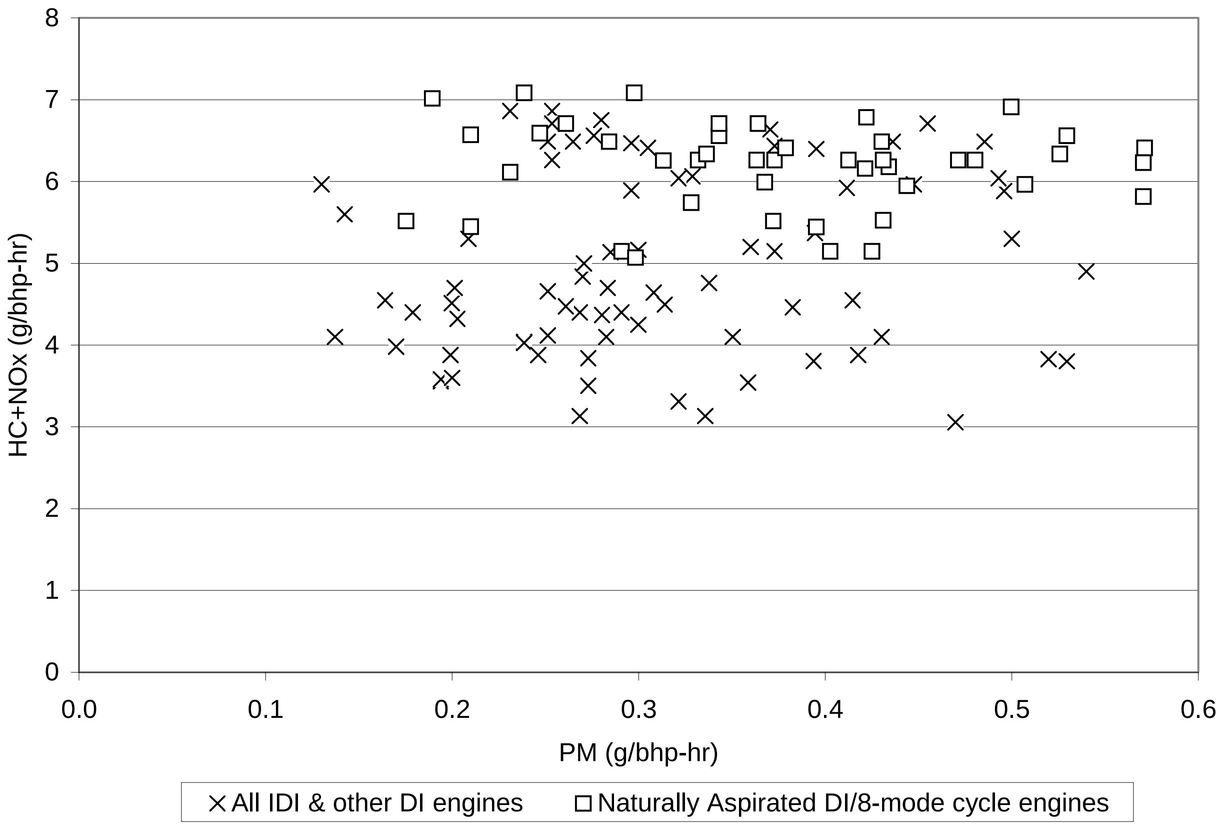
187 See Table 3-2 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

188 As discuss in Section III.B., manufacturers can choose, at their option, to pull-ahead the 2013 PM standard for the 50-75 hp engines to 2012, in which case they do not need to comply with the transitional 2008 PM standard.

189 The Tier 1 standards for this power category must be demonstrated on one of a variety of different engine test cycles. The appropriate test cycle is selected by the engine manufacturer based on the intended in-use application of the engine.

data for engines in the 25-50 hp range. As can be seen in the figure, the emission levels cover a wide range. Figure III.E-1 highlights a specific example of this wide range: engines using naturally aspirated DI technology and tested on the 8-mode test cycle. Even for this subset of DI engines achieving approximately the same HC+NOx level of ~6.5 g/bhp-hr, the PM rates vary from approximately 0.2 to more than 0.5 g/bhp-hr. There is limited information available to indicate why for these small diesel engines with similar technology operating at approximately the same HC+NOx level the PM emission rates cover such a broad range. We are therefore not predicating the proposed 2008 PM standard on the combination of diesel oxidation catalysts and the lowest engine-out emissions being achieved today, because it is uncertain whether or not additional engine-out improvements would lower all engines to the proposed 2008 PM standard. Instead, we believe there are two likely means by which companies can comply with the proposed 2008 PM standard. First, some engine manufacturers can comply with this standard using known engine-out techniques (e.g., optimizing combustion chamber designs, fuel-injection strategies). However, based on the available data it is unclear whether engine-out techniques will work in all cases. Therefore, we believe some engine companies will choose to use a combination of engine-out techniques and diesel oxidation catalysts, as discussed below.

FIGURE III.E-1 -- EMISSION CERTIFICATION DATA FOR 25-50 HP MODEL YEAR 2002 ENGINES



For those engines which do not already meet the proposed 2008 Tier 4 PM standard, a number of engine-out technologies are available to achieve the standards by 2008. In our recent Staff Technical Paper on the feasibility of the Tier 2 and Tier 3 standards, we projected that in order to comply with the Tier 3 standards, engines greater than 50 hp would rely on some combination of a number of technologies, including electronic fuel systems such as electronic rotary pumps or common-rail fuel systems.[190] In addition to enabling the Tier 3 NMHC+NOx standards, electronic fuel systems with high injection pressure and the capability to perform pilot-injection and rate-shaping, have the potential to substantially reduce PM emissions.[191] Even for mechanical fuel systems, increased injection pressures can reduce PM emissions substantially.[192] As discussed above, we are projecting that the Tier 3 engine technologies used in engines between 50 and 75 hp, such as turbocharging and electronic fuel systems, will make their way into engines in the 25-50 hp range. However, we do not believe this technology will be required to achieve the proposed 2008 PM standard. As demonstrated by the 2002 certification data, engine-out techniques such as optimized combustion chamber design, fuel injection pressure increases and fuel injection timing can be used to achieve the proposed standards for many of the engines in the 25-75 hp category without the need to add turbocharging or electronic fuel systems.

For those engines which are not able to achieve the proposed standards with known engine-out techniques, we project that diesel oxidation catalysts can be used to achieve the proposed standards. DOCs are passive flow-through emission control devices which are typically coated with a precious metal or a base-metal washcoat. DOCs have been proven to be durable in use on both light-duty and heavy-duty diesel applications. In addition, DOCs have already been used to control carbon monoxide on some nonroad applications.[193]

Certain DOC formulations can be sensitive to diesel fuel sulfur level, and depending on the level of emission reduction necessary, sulfur in diesel fuel can be an impediment to PM reductions. As discussed in Section III.E.1.a, precious metal oxidation catalysts can oxidize the sulfur in the fuel and form particulate sulfates. However, even with today's high sulfur nonroad fuel, some manufacturers have demonstrated that a properly formulated DOC can be used to

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[190] See Section 2.2 through 2.3 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

[191] Ikegami, M., K. Nakatani, S. Tanaka, K. Yamane: "Fuel Injection Rate Shaping and Its Effect on Exhaust Emissions in a Direct-Injection Diesel Engine Using a Spool Acceleration Type Injection System", SAE paper 970347, 1997. Dickey D.W., T.W. Ryan III, A.C. Matheaus: "NOx Control in Heavy-Duty Engines-What is the Limit?", SAE paper 980174, 1998. Uchida N, K. Shimokawa, Y. Kudo, M. Shimoda: "Combustion Optimization by Means of Common Rail Injection System for Heavy-Duty Diesel Engines", SAE paper 982679, 1998.

[192] "Effects of Injection Pressure and Nozzle Geometry on DI Diesel Emissions and Performance," Pierpont, D., and Reitz, R., SAE Paper 950604, 1995.

[193] EPA Memorandum "Documentation of the Availability of Diesel Oxidation Catalysts on Current Production Nonroad Diesel Equipment", William Charmley. Copy available in EPA Air Docket A-2001-28.

achieve the existing Tier 2 PM standards for larger engines (i.e., the 0.15 g/bhp-hr standard).[194] However, given the high level of sulfur in nonroad fuel today, the use of DOCs as a PM reduction technology is severely limited. Data presented by one engine manufacturer regarding the existing Tier 2 PM standard shows that while a DOC can be used to meet the current standard even when tested on 2,000 ppm sulfur fuel, lowering the fuel sulfur level to 380 ppm enabled the DOC to reduce PM by 50 percent from the 2,000 ppm sulfur fuel.[195] Without the availability of 500 ppm sulfur fuel in 2008, DOCs would be of limited use for nonroad engine manufacturers and would not provide the emissions necessary to meet the proposed standards for most engine manufacturers. With the availability of 500 ppm sulfur fuel, DOC's can be designed to provide PM reductions on the order of 20 to 50%, while suppressing particulate sulfate reduction. These levels of reductions have been seen on transient duty cycles as well as highway and nonroad steady-state duty cycles.[196] As discussed in Section VII of this preamble, the 2008 PM standard must be met on the existing nonroad steady-state cycle, the supplemental standards (nonroad transient cycle and NTE) are not implemented until 2013 for this power category. As discussed above, 24 engine families in the 25-50 hp range are within 30 percent of the proposed 2008 PM standard and are at or below the 2008 NMHC+NOx standard for this power range, indicating that use of DOCs should readily achieve the incremental improvement necessary to meet the proposed 2008 PM standard.

Based on the existence of a number of engine families which already comply with the proposed 0.22 g/bhp-hr PM standard (and the 2008 NMHC+NOx standard), and the availability of well known PM reduction technologies such as engine-out improvements and diesel oxidation catalysts, we project the proposed 0.22 g/bhp-hr PM standards is technologically feasible by model year 2008. All of these are conventional technologies which have been used on both highway and nonroad diesel engines in the past. As such, we do not expect there to be any negative impacts with respect to noise or safety. In addition, PM reduction technologies such as improved combustion through the use of higher pressure fuel injection systems have the potential to improve fuel efficiency. DOCs are not predicted to have any substantial impact on fuel efficiency.

As discussed in Section III.B, we have also proposed a minor change in the CO standard for the 25-50 hp engines, in order to align it with the standard for the 50-75 hp engines. As discussed in Section III.B., this small change in the CO standard is intended to simplify EPA's

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[194] See Table 2-4 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

[195] See Table 2-4 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

[196] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-duty Engines to Achieve Low Emission Levels: Interim Report Number 1 - Oxidation Catalyst Technology, copy available in EPA Air Docket A-2001-28. "Reduction of Diesel Exhaust Emissions by Using Oxidation Catalysts," Zelenka et. al., SAE Paper 90211, 1990. See Table 2-4 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001, copy available in EPA Air Docket A-2001-28.

regulations as part of our decision to propose a reduction in the number of engine power categories for Tier 4. The current CO standard for this category is 4.1 g/bhp-hr, and the proposed standard is 3.7 g/bhp-hr (i.e., the current standard for engines in the 50-75 hp range). The model year 2002 certification data shows that more than 95 percent of the engine families in the 25-50 hp engine range meet the proposed CO standard today. In addition, a recent EPA test program run by a contractor on two nonroad diesel engines in this power range showed that CO emissions were well below the proposed standards not only when tested on the existing steady-state 8-mode test procedure, but also when tested on the nonroad transient duty cycle we are proposing in today's action.[197] Finally, DOCs typically reduce CO emissions on the order of 50 percent or more, on both transient and steady-state conditions.[198] Given that more than 95 percent of the engines in this category meet the proposed standard today, and the ready availability of technology which can easily achieve the proposed standard, we project this CO standard will be achievable by model year 2008.

ii. 2013 Standards

For engines in the 25-50 range, we are proposing standards commencing in 2013 of 3.5 g/bhp-hr for NMHC+NOx and 0.02 g/bhp-hr for PM. For the 50-75 hp engines, we are proposing a 0.02 g/bhp-hr PM standard which will be implemented in 2013, and for those manufacturers who choose to pull-ahead the standard one-year, 2012 (manufacturers who choose to pull-ahead the 2013 standard for engine in the 50-75 range do not need to comply with the transitional 2008 PM standard).

PM Standard

Sections III.E.1 through III.E.3 have already discussed catalyzed diesel particulate filters, including explanations of how CDPFs reduce PM emissions, and how to apply CDPFs to nonroad engines. We concluded there that CDPFs can be used to achieve the proposed PM standard for engines $\geq$75 hp. As also discussed in Section III.E.2.a, PM filters will require active back-up regeneration systems for many nonroad applications above and below 75 hp because low temperature operation is an issue across allpower categories. A number of secondary technologies are likely required to enable proper regeneration, including possibly electronic fuel systems such as common rail systems which are capable of multiple post-injections which can be used to raise exhaust gas temperatures to aid in filter regeneration.

Particulate filter technology, with the requisite trap regeneration technology, can also be applied to engines in the 25 to 75 hp range. The fundamentals of how a filter is able to reduce PM

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[197] See Tables 6, 8, and 14 of "Nonroad Emission Study of Catalyzed Particulate Filter Equipped Small Diesel Engines" Southwest Research Institute, September 2001. Copy available in EPA Air Docket A-2001-28.

[198] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-duty Engines to Achieve Low Emission Levels: Interim Report Number 1 - Oxidation Catalyst Technology and "Reduction of Diesel Exhaust Emissions by Using Oxidation Catalysts", P. Zelenka et. al., Society of Automotive Engineers paper 902111, October 1990.

emissions as described in Section III.E.1. are not a function of engine power, and CDPF's are just as effective at capturing soot emissions and oxidizing SOF on smaller engines as on larger engines. As discussed in more detail below, particulate sulfate generation rates are slightly higher for the smaller engines, however, we have addressed this issue in our proposal. The PM filter regeneration systems described in Section III.E.1 and 2 are also applicable to engines in this size range and are therefore likewise feasible. There are specific trap regeneration technologies which we believe engine manufacturers in the 25-75 hp category may prefer over others. Specifically, an electronically-controlled secondary fuel injection system (i.e., a system which injects fuel into the exhaust upstream of a PM filter). Such a system has been commercially used successfully by at least one nonroad engine manufacturer, and other systems have been tested by technology companies.[199]

We are, however, proposing a slightly higher PM standard (0.02 g/bhp-hr rather than 0.01) for these engines. As discussed in Section III.E.1.a, with the use of a CDPF, the PM emissions emitted by the filter are primarily derived from the fuel sulfur. The smaller power category engines tend to have higher fuel consumption than larger engines. This occurs for a number of reasons. First, the lower power categories include a high fraction of IDI engines which by their nature consume approximately 15 percent more fuel than a DI engine. Second, as engine displacements get smaller, the engine's combustion chamber surface-to-volume ratio increases. This leads to higher heat-transfer losses and therefor lower efficiency and higher fuel consumption. In addition, frictional losses are a higher percentage of total power for the smaller displacement engines which also results in higher fuel consumption. Because of the higher fuel consumption rate, we expect a higher particulate sulfate level, and therefore we have proposed a 0.02 g/bhp-hr standard.

Test data confirm that this proposed standard is achievable. In 2001, EPA completed a test program run by a contractor on two small nonroad diesel engines (a 25 hp IDI engine and a 50 hp IDI engine) which demonstrated the proposed 0.02 g/bhp-hr standard can be achieved with the use of a CDPF.[200] This test program included testing on the existing 8-mode steady-state test cycle as well as the nonroad transient cycle proposed in today's action. The 0.02g/bhp-hr level was achieved on each engine over both test cycles. One of the engines was also tested on the proposed constant speed, variable load transient cycle with a particulate filter, and this engine also met the proposed 0.02 g/bhp-hr PM standard.[201] This test program also demonstrates why EPA has proposed a slightly higher PM standard for the 25 - 75 hp category (0.02 g/bhp-hr vs 0.01). The data from the test program described above showed fuel consumption rates over the 8-mode

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[199] "The Optimized Deutz Service Diesel Particulate Filter System II", H. Houben et. al., SAE Technical Paper 942264, 1994 and "Development of a Full-Flow Burner DPF System for Heavy Duty Diesel Engines, P. Zelenka et. al., SAE Technical Paper 2002-01-2787, 2002.

[200] See Tables 6, 8, and 14 of "Nonroad Emission Study of Catalyzed Particulate Filter Equipped Small Diesel Engines" Southwest Research Institute, September 2001. Copy available in EPA Air Docket A-2001-28.

[201] See Tables 8 of "Nonroad Emission Study of Catalyzed Particulate Filter Equipped Small Diesel Engines" Southwest Research Institute, September 2001. Copy available in EPA Air Docket A-2001-28. Note that the "AWQ" cycle specified in Table 8 is the same as the proposed constant speed, variable load cycle.

test procedure between 0.4 and 0.5 lbs/bhp-hr, while typical values for a modern turbocharged DI engine with 4-valves per cylinder in the ≥75 hp categories are on the order of 0.3 to 0.35 lbs/hp-hr. However, the data is less conclusive with respect to the proposed NTE standard. The test program at SwRI included a number of individual steady-state emission points which are within the proposed NTE control zone for nonroad diesel engines. For most of these points, the emissions were well below the proposed NTE standard for both engines. However, both engines included as a test point the maximum torque test point, and in each case the emissions were above the proposed NTE standard. For one engine, the engine-out emissions were 1.2 g/bhp-hr PM and when equipped with a CDPF the emissions were 0.05 g/bhp-hr. While this is more than a 95 percent reduction in PM, 0.05 is above our proposed NTE standard of 0.03 g/bhp-hr. The second test engine at the maximum torque mode produced an engine-out PM value of 0.35 g/bhp-hr, and when equipped with a CDPF the results were 0.04g/bhp-hr. While this is nearly a 90 percent reduction in PM, the engines do not meet the proposed NTE standard. We believe these results are a combination of high engine-out PM emissions as well as high exhaust gas temperature. While a CDPF is very effective at reducing PM emissions, it is not 100 percent effective. These engines would likely require additional engine-out PM reductions at the maximum torque mode in order to comply with the proposed NTE standard. In addition, the peak torque mode is one of the highest exhaust gas temperature mode, and therefore one of the highest particulate-sulfate generating modes when equipped with a CDPF. More careful management of the engine-out temperature at this mode, such as by altering the engines air-fuel ratio, may be necessary to lower the engine-out temperature and comply with the proposed NTE standard.

NMHC+NOx Standard

We have proposed a 3.5 g/bhp-hr NMHC+NOx standard for engines in the 25 - 50 hp range for 2013. This will align the NMHC+NOx standard for engines in this power range with the Tier 3 standard for engines in the 50 - 75 hp range which are implemented in 2008. EPA's recent Staff Technical paper which reviewed the technological feasibility of the Tier 3 standards contains a detailed discussion of a number of technologies which are capable of achieving a 3.5 g/bhp-hr standard. These include cooled EGR, uncooled EGR, as well as advanced in-cylinder technologies relying on electronic fuel systems and turbocharging.[202] These technologies are capable of reducing NOx emission by as much as 50 percent. Given the Tier 2 NMHC+NOx standard of 5.6 g/bhp-hr, a 50 percent reduction would allow a Tier 2 engine to comply with the 3.5 g/bhp-hr NMHC+NOx standard proposed in this action. In addition, because this NMHC+NOx standard is concurrent with the 0.02 g/bhp-hr PM standards which we project will be achievable with the use of particulate filters, engine designers will have significant additional flexibility in reducing NOx because the PM filter will eliminate the traditional concerns with the engine-out NOx vs. PM trade-off. Our recent highway 2004 standard review rulemaking (see 65 FR 59896) demonstrated that a diesel engine with advanced electronic fuel injection technology as well as NOx control technology such as cooled EGR is capable of complying with an NTE standard set at 1.25 times the laboratory based-standard FTP standard. We project that the same technology (electronic fuel systems and cooled EGR) are also capable for engine in the 25-75 hp

[202] See Section 2.2 through 2.3 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

range of complying with the proposed NTE standard of 4.4 g/bhp-hr NMHC+NOx (1.25 x 3.5) in 2013. This is based on the broad NOx reduction capability of cooled EGR technology, which is capable of reducing NOx emissions across the engine operating map by at least 30 percent even under high load conditions.[203]

Based on the information available to EPA and presented here, and giving appropriate consideration to the lead time necessary to apply the technology as well, we have concluded the proposed 0.02 g/bhp-hr PM standard for engines in the 25 - 75 hp category and the 3.5 g/bhp-hr NMHC+NOx standards for the 25 - 50 hp engines are achievable.

d. Why EPA has not proposed more stringent Tier 4 NOx standards

Today's notice proposes to revise the NMHC+NOx standard for engines between 25 and 50 hp to a level of 3.5 g/bhp-hr beginning in 2013 (the same numeric level as the Tier 3 standards for engines in the 50 - 75 hp range). As discussed below, we believe this standard can be met using a variety of technologies, including but not limited to cooled EGR. Similar technologies will be used on engines in the 50 - 100 hp range beginning in 2008. At this time, we are not proposing further reductions in the NOx standards for engines between 25 and 75 hp.

As discussed in Section III.B.1.d, engines $\geq$75 hp are similar to, or are direct derivatives of, highway HDDEs. As discussed in Section III.E.1 - III.E.3, NOx adsorber technology is being developed today in order to comply with the 2007 highway heavy-duty standards. However, NOx adsorber technologies will require additional development beyond what has occurred at this time in order to achieve the 2007 highway standards. Section III.E.1 - III.E.3 also discuss the high degree of complexity and engine/aftertreatment integration which will be required in order for NOx adsorbers to be applied successfully to nonroad diesel engines.
As discussed above, and as illustrated in Table III.E-3, engines <75 hp include a significant fraction of naturally aspirated engines and engines with indirect-injection fuel systems, and we are not predicting a significant shift away from IDI technology engines. Given the relatively unsophisticated level of technology used in this power category today, as well as our prediction that even in the 2011-13 time frame these engines will lag significantly behind the $\geq$75 hp engines, we believe it is appropriate not to propose NOx adsorber based standards at this time. Rather, as discussed in Section III.H, we have proposed to undertake a technology assessment in the 2007 time frame which would evaluate the status of emission control technologies for engines less than 75 hp, and such a review would revisit this issue. In addition, Section VI of this proposal contains additional discussion regarding our analysis of applying NOx adsorbers to engines in the 25-75 hp category. EPA invites further comment on the above discussion, and also solicits comment on the cost impacts of NOx aftertreatment devices, including unit costs, on these engines.

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[203] See Section 8 of "Control of Emissions of Air Pollution from 2004 and Later Model Year Heavy-Duty Highway Engines and Vehicles: Response to Comments", EPA document EPA420-R-00-011, July 2000, and Chapter 3 of "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-duty Engines", EPA document EPA420-R-00-010, July 2000. Copies of both documents available in EPA docket A-2001-28.

5. Are the Standards Proposed for Engines <25 hp Feasible?

As discussed in Section III.B, our proposal for standards for engines less than 25 hp is a new PM standard of 0.30 g/bhp-hr beginning in 2008. As discussed below, we are not proposing to set a new standard more stringent than the existing Tier 2 NMHC+NOx standard for this power category at this time. This section describes:
- what makes the <25 hp category unique;
- engine technology currently used in the <25 hp category;
- why the proposed standards are technologically feasible; and,
- why EPA has not proposed more stringent standards at this time.

a. What makes the < 25 hp category unique?

Nonroad engines less than 25 hp are the least sophisticated nonroad diesel engines from a technological perspective. All of the engines currently sold in this power category lack electronic fuel systems and turbochargers (see Table III.E-3). Nearly 50 percent of the products have two-cylinders or less, and 14 percent of the engines sold in this category are single-cylinder products, a number of these have no batteries and are crank-start machines, much like today's simple walk behind lawnmower engines. In addition, given what we know today and taking into account the Tier 2 standards which have not yet been implemented, we are not projecting any significant penetration of advanced engine technology, such as electronically controlled fuel systems, into this category in the next 5 to 10 years.

We have proposed a PM standard for engines in the <25 hp category which is higher than the standard proposed for engines in the 25-75 hp category (0.30 g/bhp-hr vs. 0.22 g/bhp-hr). We have done this for a number of reasons. First, the existing Tier 2 PM standards specifies standards which become numerically higher for the smaller power categories. Specifically, for engines >175 hp, the Tier 2 PM standard is 0.15 g/bhp-hr, which increases to 0.30 g/bhp-hr for engines in the 50-100hp range, 0.45 g/bhp-hr for engines in the 25-50hp range, and finally 0.60 g/bhp-hr for engines <25 hp. In the Tier 2 time frame, engines in the higher power categories are expected to use more sophisticated technologies such as turbocharging and high pressure electronically controlled fuel systems. These technologies are more capable of reducing PM emissions as compared to naturally aspirated engines with lower pressure mechanical fuel systems. To some extent this same trend is expected to continue in the 2008 time frame. As discussed above, we expect that many engines in the 25-75hp engine category will use turbocharging, and some engines will have electronic fuel systems. However, we are not predicting that any engines in the <25hp category will use either of these technologies. In addition, very small diesel engines present a number of unique challenges for reducing PM emissions. First, the smaller engines inherently have high combustion chamber surface-to-volume ratios. This results in higher heat loss, which results in a quenching of the oxidation process earlier than for larger engines, and therefore higher PM emission rates. In addition, the small diesel engines are more limited in the PM reduction which can be achieved by higher fuel injection pressures. Due to the very small size of the combustion chamber, high pressure injection (which is intended to improve fuel atomization and mixing, both of which lower PM emissions) will result in fuel impaction on the combustion chamber, which will not improve fuel atomization. The benefits of higher pressure fuel injection as a PM reduction technology therefore reaches a point of diminishing returns with higher and higher pressures, and this point of diminishing returns is reached much quicker for the smaller engines than for the larger engines. For these reasons we have proposed a 2008 PM standard for engines <25 hp which is higher than the proposed 2008 PM standard for engines in the 25-75 hp category.

b. What engine technology is currently used in the <25 hp category?

In the 1998 nonroad diesel rulemaking we established Tier 1 and Tier 2 standards for these products. Tier 1 was implemented in model year 2000, and Tier 2 will be implemented in model year 2005. As discussed in EPA's recent Staff Technical Paper, we project the Tier 2 standards will be met by basic engine-out emission optimization strategies.[204] We are not predicting that Tier 2 will require electronic fuel systems, EGR, or turbocharging. As discussed in the Staff Technical Paper, a large number of engines in this power category already meet the Tier 2 standards by a wide margin.[205]

Two basic types of engine fuel injection technologies are currently present in the less than 25 hp category, mechanical indirect injection (IDI) and mechanical direct injection (DI). As discussed in Section III.D.4, the IDI system injects fuel into a pre-chamber rather than directly into the combustion chamber as in the DI system. This difference in fuel systems results in substantially different emission characteristics, as well as several important operating parameters. In general, as noted earlier, the IDI engine has lower engine-out PM and NOx emissions, while the DI engine has better fuel efficiency and lower heat rejection.

c. What data indicates that the proposed standards are feasible?

We project the proposed Tier 4 PM standard can be met by 2008 based on:
-- the existence of a large number of engine families which meet the proposed standards today;
-- the use of engine-out reduction techniques; and
-- the use of diesel oxidation catalysts.

We have examined the recent model year (2002) engine certification data for nonroad diesel engines less than 25 hp. These data indicate that a number of engine families meet the proposed Tier 4 PM standard (and the 2008 NMHC+NOx standard, unchanged from Tier 2) today. The current data indicates approximately 28% of the engine families are at or below the proposed PM standard today, while meeting the 2008 NMHC+NOx standard. These include both

[204] See Section 3 of "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

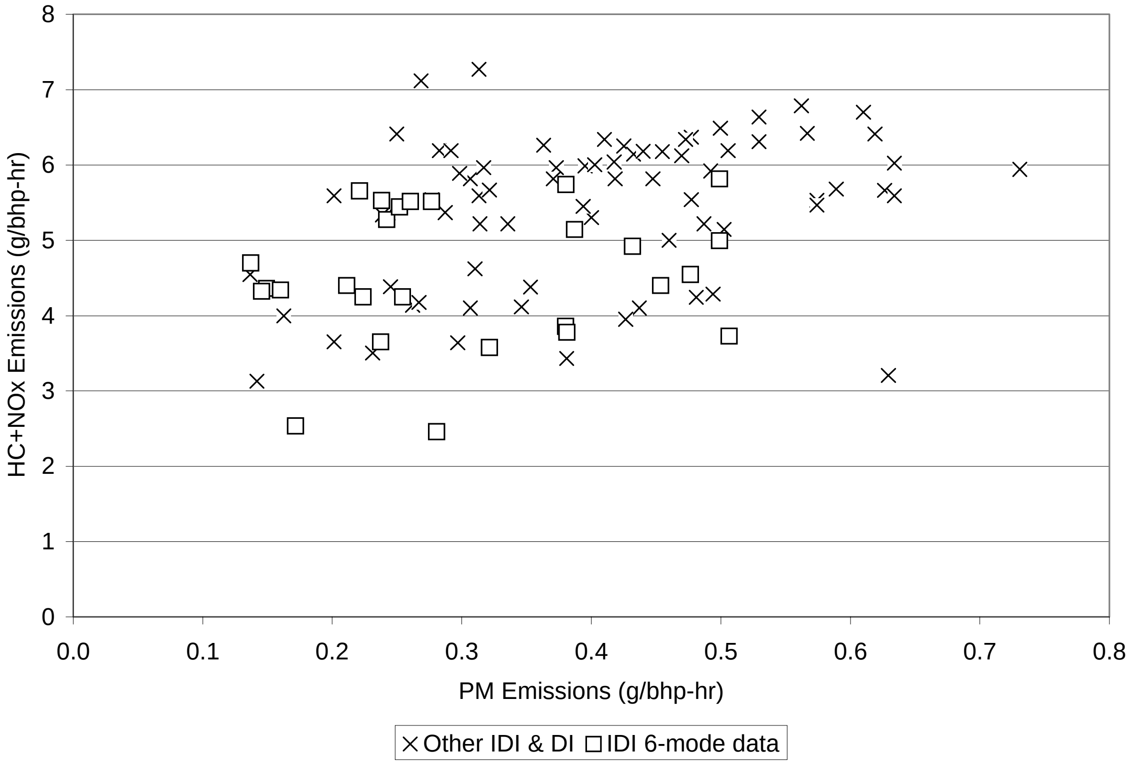
[205] See Table 3-2 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

IDI and DI engines, as well as a range of certification test cycles.[206] Many of the engine families are certified well below the proposed Tier 4 standard while meeting the 2008 NMHC+NOx level. Specifically, 15 percent of the engine families exceed the proposed Tier 4 PM standard by more than 20 percent. The public certification data indicate that these engines do not use turbocharging, electronic fuel systems, exhaust gas recirculation, or aftertreatment technologies.

These model year 2002 engines use well known engine-out emission control technologies, such as combustion chamber design and fuel injection timing control strategies, to comply with the existing standards. As with 25-75 hp engines, these data have a two-fold significance. First, they indicate that a number of engines in this power category can already achieve the proposed 2008 standard for PM using only engine-out technology, and that other engines should be able to achieve the standard making improvements just to engine-out performance. Second, despite being certified to the same emission standards with similar engine technology, the emission levels from these engines vary widely. Figure III.E-2 is a graph of the model year 2002 HC+NOx and PM data. As can be seen in the figure, the emission levels cover a wide range. Figure III.E-2 highlights a specific example of this wide range: engines using naturally aspirated IDI technology and tested on the 6-mode test cycle. Even for this subset of IDI engines achieving approximately the same HC+NOx level of~4.5 g/bhp-hr, the PM rates vary from approximately 0.15 to 0.5 g/bhp-hr. (A more detailed discussion of this data is contained in the draft RIA.) There is limited information available to indicate why for these small diesel engines with similar technology operating at approximately the same HC+NOx level the PM emission rates cover such a broad range. We are therefore not predicating the proposed 2008 PM standard on the combination of diesel oxidation catalysts and the lowest engine-out emissions being achieved today, because it is uncertain whether or not additional engine-out improvements would lower all engines to the proposed 2008 PM standard. Instead, we believe there are two likely means by which companies can comply with the proposed 2008 PM standard. First, some engine manufacturers can comply with this standard using known engine-out techniques (e.g., optimizing combustion chamber designs, fuel-injection strategies). However, based on the available data it is unclear whether engine-out techniques will work in all cases. Therefore, we believe some engine companies will choose to use a combination of engine-out techniques and diesel oxidation catalysts, as discussed below.

[206] The Tier 1 and Tier 2 standards for this power category must be demonstrated on one of a variety of different engine test cycles. The appropriate test cycle is selected by the engine manufacturer based on the intended in-use applications(s) of the engine.

FIGURE III.E-2 -- EMISSION CERTIFICATION DATA FOR <25 HP MODEL YEAR 2002 ENGINES



PM emissions can be reduced through in-cylinder techniques for small nonroad diesel engines using similar techniques as used in larger nonroad and highway engines. As discussed in Section III.E.1.a, there are a number of technologies which exist that can influence oxygen content and in-cylinder mixing (and thus lower PM emissions) including improved fuel injection systems and combustion system designs. For example, increased injection pressure can reduce PM emissions substantially.[207] The wide-range of emission characteristics present in the existing engine certification data is likely a result of differences in fuel systems and combustion chamber designs. For many of the engines which have higher emission levels, further optimization of the fuel system and combustion chamber can provide additional PM reductions.

Diesel oxidation catalysts (DOC) also offer the opportunity to reduce PM emissions from the engines in this power category. DOCs are passive flow through emission control devices which are typically coated with a precious metal or a base-metal wash-coat. DOCs have been proven to be durable in-use on both light-duty and heavy-duty diesel applications. In addition, DOCs have already been used to control carbon monoxide on some nonroad applications.[208] However, as discussed in Section III.E.1.a., certain DOC formulations can be sensitive to diesel fuel sulfur level. Specifically, precious-metal based oxidation catalysts (which have the greatest potential for reducing PM) can oxidize the sulfur in the fuel and form particulate sulfates. Given the high level of sulfur in nonroad fuel today, the use of DOCs as a PM reduction technology is severely limited. Data presented by one engine manufacturer regarding the existing Tier 2 PM standard shows that while a DOC can be used to meet the current standard when tested on 2,000 ppm sulfur fuel, lowering the fuel sulfur level to 380 ppm enabled the DOC to reduce PM by 50 percent from the 2,000 ppm sulfur fuel.[209] Without the availability of 500 ppm sulfur fuel in 2008, DOCs would be of limited use for nonroad engine manufacturers and would not provide the emissions necessary to meet the proposed standards for most engine manufacturers. With the availability of 500 ppm sulfur fuel, DOC's can be designed to provide PM reductions on the order of 20 to 50%, while suppressing particulate sulfate reduction. These levels of reductions have been seen on transient duty cycles as well as highway and nonroad steady-state duty cycles.[210] As discussed in Section III.D, we are proposing to apply supplemental test procedures and standards (nonroad transient test cycle and not-to-exceed requirements) to engines in the <25 hp category beginning in 2013. The supplemental test procedures and standards will apply not only to PM, but also to NMHC+NOx. While we believe the engine technology necessary to comply with the

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207 "Effects of Injection Pressure and Nozzle Geometry on DI Diesel Emissions and Performance," Pierpont, D., and Reitz, R., SAE Paper 950604, 1995.

208 EPA Memorandum "Documentation of the Availability of Diesel Oxidation Catalysts on Current Production Nonroad Diesel Equipment", William Charmley. Copy available in EPA Air Docket A-2001-28.

209 See Table 2-4 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

210 "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-duty Engines to Achieve Low Emission Levels: Interim Report Number 1 - Oxidation Catalyst Technology, copy available in EPA Air Docket A-2001-28. "Reduction of Diesel Exhaust Emissions by Using Oxidation Catalysts," Zelenka et. al., SAE Paper 90211, 1990. See Table 2-4 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001, copy available in EPA Air Docket A-2001-28.

supplemental test procedures and standards is the same as the technology necessary to comply with the 2008 standard, we are delaying the implementation of the supplemental test procedures and standards until 2013 in order to implement the supplemental requirements on the larger powered nonroad engines before the smallest power category (see Section III.C. above). This will also provide engine manufacturers with additional time to install any emission testing equipment upgrades they may need in order to implement the new nonroad transient test cycle. Nevertheless, the technologies described above are capable of complying with both the proposed nonroad transient test cycle and the NTE standard. As just described, DOCs are capable of reducing PM emissions up to 50 percent during transient testing. With respect to feasibility under NTE testing, it has been demonstrated, as a result of a recent Agency action, that engines which rely on retarded injection timing as a primary NOx control technology, which is also the primary technology that engines in the <25 hp category will likely use to comply with the Tier 2 NMHC+NOx standard, are capable of complying with an NMHC+NOx NTE standard of 1.25 x the FTP for engines with emission levels on the order of 4 g/bhp-hr NOx. Specifically, as a result of federal consent decrees with a number of highway heavy-duty diesel engine manufactures, many highway engines certified to an FTP standard of 4 g/bhp-hr NOx were also designed to comply with an NTE limit of 5 g/bhp-hr (i.e., 1.25 x FTP standard).[211] The Tier 2 NMHC+NOx standard for engines <25hp is 5.6 g/bhp-hr, therefore, in 2013 the proposed NTE standard is 7.0 g/bhp-hr NMHC+NOx. Based on the experience which a number of highway diesel engine companies, we project that the proposed NTE standard for engines <25 hp can be achieved by 2013.

As discussed in Section III.B, we have also proposed a minor change in the CO standard for the <11 hp engines, in order to align those standards with the standards for the 11-25 hp engines. As discussed in Section III.B., the small change in the CO standard is intended to simplify EPA's regulations as part of our decision to propose a reduction in the number of engine power categories for Tier 4. The current CO standard for this category is 6.0 g/bhp-hr, and the proposed standard is 4.9 g/bhp-hr (i.e., the current standard for engines in the 11-25 hp range). The model year 2002 certification data shows that more than 90 percent of the engine families in this power category meet the proposed standards today. In addition, DOCs typically reduce CO emissions on the order of 50 percent or more during both transient and steady-state operation.[212] Given that more than 90 percent of the engines in this category meet the proposed standard today, and the ready availability of technology which can easily achieve the proposed standard, we project this CO standard will be achievable by model year 2008.

Based on the existence of a number of engine families which already comply with the proposed Tier 4 PM standard (and the 2008 NMHC+NOx standard), and the availability of PM

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[211] EPA Memorandum "Summary of Model Year 1999 and 2000 Federal On-highway Heavy-duty Diesel Engine Families Certified as Compliant with Not-to-Exceed Requirements, Euro-3 Steady State Requirements, and Maximum Allowable Emission Limits Requirements", copy available in EPA Air Docket A-2001-28.

[212] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-duty Engines to Achieve Low Emission Levels: Interim Report Number 1 - Oxidation Catalyst Technology, and "Reduction of Diesel Exhaust Emissions by Using Oxidation Catalysts", P. Zelenka et. al., Society of Automotive Engineers paper 902111, October 1990.

reduction technologies such as improved fuel systems, combustion chamber improvements, and in particular diesel oxidation catalysts, we project the proposed 0.30 g/bhp-hr PM standards is technologically feasible by model year 2008. All of these are conventional technologies which have been used on both highway and nonroad diesel engines in the past. As such, we do not expect there to be any negative impacts with respect to noise or safety. In addition, PM reduction technologies such as improved combustion through the use of higher pressure fuel injection systems as well as DOCs are not predicted to have any substantial impact on fuel efficiency.

d. Why has EPA not proposed more stringent PM or NOx standards for engines < 25 hp?

Section III.E.4 contains a detailed discussion of why we don't believe it is appropriate at this time to revise the NOx standards based on NOx absorber technology for engines between 25 and 75 hp. These same arguments apply for engines below 25 hp. In addition, we have not proposed to revise the NOx standard for <25 hp engines in this action, nor do we believe PM standards based on particulate filters are appropriate for this power category based on a number of factors, as discussed below.

In EPA's recent Staff Technical Paper regarding the feasibility of the Tier 3 NMHC+NOx standards for engines greater than 50 hp, we projected that a number of engine technologies can be used to meet the Tier 3 standards, including cooled EGR or hot EGR, both with advanced electronic fuel systems, as well as with internal combustion techniques using advanced electronic fuel systems, advanced turbocharging systems (e.g., waste-gated or variable geometry turbochargers), and possibly variable valve actuation.[213] In addition, we presumed the use of charge-air cooling In order to set more stringent NOx standards for <25 hp engines without increasing PM emissions, the most logical list of technologies is turbocharging, electronically controlled hot or cooled EGR, an electronic fuel system, and possibly charge-air-cooling. No nonroad diesel engine <25 hp uses any combination of these technologies today. While we are able to postulate that some of this technology could be applied to the <25 hp engines, the application of some of the technology (such as turbocharging) is technologically uncertain. It is the combination of these two issues (the traditional NOx-PM trade-off and the difficulties with turbocharging 1 and 2 cylinder engines) which is the primary reason we are not proposing to revise the NOx standard for engines in this size range. NOx reduction control technologies such as advancing fuel injection timing or using EGR will increase PM emissions. In order to reduce NOx emissions and reduce or maintain current PM levels additional technologies must be used. Fundamental among these is the need to increase oxygen content, which can be achieved principally with turbocharging. However, turbocharging systems do not lend themselves to 1 and 2 cylinder products, which are approximately 50 percent of the engines in this power category. In addition, even if these technologies could be applied to engines in the < 25 hp category, the costs would be substantial relative to both the base engine cost and to the cost of the nonroad equipment itself . Therefore, for the reasons discussed above, we have not proposed to revise the NOx standard for these engines at this time. As discussed in Section III.H, we have proposed that a

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[213] See Section 2.3.1 through 2.3.3 of "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

technology assessment occur in 2007 which would evaluate the status of emission control technologies for engines less than 75 hp, and such a review would revisit this issue.

In addition, we have not proposed to apply particulate filter based standards for engines less than 25 hp. As discussed in Sections III.E.1 through 4, there are two basic types of particulate filter systems we believe could be used by engine manufacturers. The first is a CDPF which uses post-injection from a common-rail electronic fuel injection system in order to ensure filter regeneration. The second type of system would use a CDPF with a stand-alone (i.e., independent from the engine's fuel system) fuel injection system to ensure filter regeneration. In either case, an electronic control system is required, as well as the CDPF. Such systems are not being developed for engines of this size for either highway light-duty or heavy-duty diesel applications, and (as noted earlier) it is unclear whether the technology development which is being done for the highway market will transfer down to engines in this power category. In addition, based on currently available information, we believe the cost of these technologies are relatively high compared to the overall cost of the equipment. As discussed in Section III.H, we have proposed that a technology assessment occur in 2007 which would evaluate the status of emission control technologies for engines less than 75 hp, and such a review would revisit this issue.

6. Meeting the Crankcase Emissions Requirements

The most common way to eliminate crankcase emissions has been to vent the blow-by gases into the engine air intake system, so that the gases can be recombusted. Prior to the HD2007 rulemaking, we have required that crankcase emissions be controlled only on naturally aspirated diesel engines. We had made an exception for turbocharged diesel engines (both highway and nonroad) because of concerns in the past about fouling that could occur by routing the diesel particulates (including engine oil) into the turbocharger and aftercooler. However, this is an environmentally significant exception since most nonroad equipment over 70hp use turbocharged engines, and a single engine can emit over 100 pounds of NOx, NMHC, and PM from the crankcase over its lifetime.

Given the available means to control crankcase emissions, we eliminated this exception for highway engines in 2007 and are proposing to eliminate the exception for nonroad diesel engines as well. We anticipate that the diesel engine manufacturers will be able to control crankcase emissions through the use of closed crankcase filtration systems or by routing unfiltered blow-by gases directly into the exhaust system upstream of the emission control equipment. However, the proposed provision has been written such that if adequate control can be had without "closing" the crankcase then the crankcase can remain "open." Compliance would be ensured by adding the emissions from the crankcase ventilation system to the emissions from the engine control system downstream of any emission control equipment. We propose to limit this provision for controlling emissions from open crankcases to turbocharged engines, which is the same as for heavy-duty highway diesel engines. We request comment on extending this provision to naturally aspirated engines, as we did for marine diesel engines in our 1999 final rule (64 FR 73300, December 29, 1999).

We expect that in order to meet the stringent tailpipe emission standards set here, that manufacturers will have to utilize closed crankcase approaches as described here. Closed crankcase filtration systems work by separating oil and particulate matter from the blow-by gases through single or dual stage filtration approaches, routing the blow-by gases into the engine's intake manifold and returning the filtered oil to the oil sump. Oil separation efficiencies in excess of 90 percent have been demonstrated with production ready prototypes of two stage filtration systems.[214] By eliminating 90 percent of the oil that would normally be vented to the atmosphere, the system works to reduce oil consumption and to eliminate concerns over fouling of the intake system when the gases are routed through the turbocharger. Hatz, a nonroad engine manufacturer, currently has closed crankcase systems on many of its turbocharged engines.

F. Why Do We Need 15ppm Sulfur Diesel Fuel?

As stated earlier, we strongly believe that fuel sulfur control is critical to ensuring the success of NOx and PM aftertreatment technologies. In order to evaluate the effect of sulfur on diesel exhaust control technologies, we used three key factors to categorize the impact of sulfur in fuel on emission control function. These factors were efficiency, reliability, and fuel economy. Taken together these three factors lead us to believe that diesel fuel sulfur levels of 15 ppm will be required for the nonroad emission standards proposed here to be feasible. Brief summaries of these factors are provided below.

The **efficiency** of emission control technologies to reduce harmful pollutants is directly affected by sulfur in diesel fuel. Initial and long term conversion efficiencies for NOx, NMHC, CO and diesel PM emissions are significantly reduced by catalyst poisoning and catalyst inhibition due to sulfur. NOx conversion efficiencies with the NOx adsorber technology in particular are dramatically reduced in a very short time due to sulfur poisoning of the NOx storage bed. In addition, total PM control efficiency is negatively impacted by the formation of sulfate PM. As explained in the following sections, the CDPF, NOx adsorber, and urea SCR catalyst technologies described here have the potential to make significant amounts of sulfate PM under operating conditions typical of many nonroad engines. We believe that the formation of sulfate PM will be in excess of the total PM standard, unless diesel fuel sulfur levels are at or below 15 ppm. Based on the strong negative impact of sulfur on emission control efficiencies for all of the technologies evaluated, we believe that 15 ppm represents an upper threshold of acceptable diesel fuel sulfur levels.

Reliability refers to the expectation that emission control technologies must continue to function as required under all operating conditions for the life of the engine. As discussed in the following sections, sulfur in diesel fuel can prevent proper operation of both NOx and PM control technologies. This can lead to permanent loss in emission control effectiveness and even catastrophic failure of the systems. Sulfur in diesel fuel impacts reliability by decreasing catalyst efficiency (poisoning of the catalyst), increasing diesel particulate filter loading, and negatively

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[214] Letter from Marty Barris, Donaldson Corporation, to Byron Bunker US EPA, March 2000. Copy available in EPA Air Docket A-2001-28.

impacting system regeneration functions. Among the most serious reliability concerns with sulfur levels greater than 15 ppm are those associated with failure to properly regenerate. In the case of the NOx adsorber, failure to regenerate the stored sulfur (desulfate) will lead to rapid loss of NOx emission control as a result of sulfur poisoning of the NOx adsorber bed. In the case of the diesel particulate filter, sulfur in the fuel reduces the reliability of the regeneration function. If regeneration does not occur, catastrophic failure of the filter could occur. It is only by the availability of low sulfur diesel fuels that these technologies become feasible.

Fuel economy impacts due to sulfur in diesel fuel affect both NOx and PM control technologies. The NOx adsorber sulfur regeneration cycle (desulfation cycle) can consume significant amounts of fuel unless fuel sulfur levels are very low. The larger the amount of sulfur in diesel fuel, the greater the adverse effect on fuel economy. As sulfur levels increase above 15 ppm, the adverse effect on fuel economy becomes more significant, increasing above one percent and doubling with each doubling of fuel sulfur level. Likewise, PM trap regeneration is inhibited by sulfur in diesel fuel. This leads to increased PM loading in the diesel particulate filter and increased work to pump exhaust across this restriction. With low sulfur diesel fuel, diesel particulate filter regeneration can be optimized to give a lower (on average) exhaust backpressure and thus better fuel economy. Thus, for both NOx and PM technologies the lower the fuel sulfur level the lower the operating costs of the vehicle.

1. Catalyzed Diesel Particulate Filters and the Need for Low Sulfur Fuel

CDPFs function to control diesel PM through mechanical filtration of the solid PM (soot) from the diesel exhaust stream and then oxidation of the stored soot (trap regeneration) and oxidation of the SOF. Through oxidation in the catalyzed diesel particulate filter the stored PM is converted to CO_2 and released into the atmosphere. Failure to oxidize the stored PM leads to accumulation in the trap, eventually causing the trap to become so full that it severely restricts exhaust flow through the device, leading to trap or vehicle failure.

Uncatalyzed diesel particulate filters require exhaust temperatures in excess of 650˚C in order for the collected PM to be oxidized by the oxygen available in diesel exhaust. That temperature threshold for oxidation of PM by exhaust oxygen can be decreased to 450˚C through the use of base metal catalytic technologies. For a broad range of operating conditions typical of in-use diesel engine operation, diesel exhaust can be significantly cooler than 400˚C. If oxidation of the trapped PM could be assured to occur at exhaust temperatures lower than 300˚C, then diesel particulate filters would be expected to be more robust for most applications and operating regimes. Oxidation of PM (regeneration of the trap) at such low exhaust temperatures can occur by using oxidants which are more readily reduced than oxygen. One such oxidant is NO_2.

NO_2 can be produced in diesel exhaust through the oxidation of the nitrogen monoxide (NO), created in the engine combustion process, across a catalyst. The resulting NO_2-rich exhaust is highly oxidizing in nature and can oxidize trapped diesel PM at temperatures as cool as

250˚C.[215] Some platinum group metals are known to be good catalysts to promote the oxidation of NO to NO_2. Therefore in order to promote more effective passive regeneration of the diesel particulate filters, significant amounts of platinum group metals (primarily platinum) are being used in the wash-coat formulations of advanced CDPFs. The use of platinum to promote the oxidation of NO to NO_2 introduces several system vulnerabilities affecting both the durability and the effectiveness of the CDPF when sulfur is present in diesel exhaust. (In essence, diesel engine exhaust temperatures are in a range necessitating use of precious metal catalysts in order to adequately regenerate the PM filter, but precious metal catalysts are in turn highly sensitive to sulfur in diesel fuel.) The two primary mechanisms by which sulfur in diesel fuel limits the robustness and effectiveness of CDPFs are inhibition of trap regeneration, through inhibition of the oxidation of NO to NO_2, and a dramatic loss in total PM control effectiveness due to the formation of sulfate PM. Unfortunately, these two mechanisms trade-off against one another in the design of CDPFs. Changes to improve the reliability of regeneration by increasing catalyst loadings lead to increased sulfate emissions and, thus, loss of PM control effectiveness. Conversely, changes to improve PM control by reducing the use of platinum group metals and, therefore, limiting "sulfate make" leads to less reliable regeneration. Even with an active regeneration system, reducing catalytic loading to reduce sulfate make unacceptably trades off regeneration effectiveness (i.e., robustness). We believe the best means of achieving good PM emission control and reliable operation is to reduce sulfur in diesel fuel, as shown in the following subsections.

a. Inhibition of Trap Regeneration Due to Sulfur

The CDPF technology relies on the generation of a very strong oxidant, NO_2, to ensure that the carbon captured by the PM trap's filtering media is oxidized under the exhaust temperature range of normal operating conditions. This prevents plugging and failure of the PM trap. NO_2 is produced through the oxidation of NO in the exhaust across a platinum catalyst. This oxidation is inhibited by sulfur poisoning of the catalyst surface.[216] This inhibition limits the total amount of NO_2 available for oxidation of the trapped diesel PM, thereby raising the minimum exhaust temperature required to ensure trap regeneration. Without sufficient NO_2, the amount of PM trapped in the diesel particulate filter will continue to increase and can lead to excessive exhaust back pressure and low engine power.

The failure mechanisms experienced by diesel particulate filters due to low NO_2 availability vary significantly in severity and long term consequences. In the most fundamental sense, the failure is defined as an inability to oxidize the stored particulate at a rate fast enough to prevent net particulate accumulation over time. The excessive accumulation of PM over time blocks the passages through the filtering media, making it more restrictive to exhaust flow. In order to continue to force the exhaust through the now more restrictive filter, the exhaust pressure upstream of the filter must increase. This increase in exhaust pressure is commonly referred to as increasing "exhaust backpressure" on the engine.

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215 Hawker, P. et al, "Experience with a New Particulate Trap Technology in Europe," SAE 970182.

216 Hawker, P. et al, "Experience with a New Particulate Trap Technology in Europe," SAE 970182.

The increase in exhaust backpressure represents increased work being done by the engine to force the exhaust gas through the increasingly restrictive particulate filter. Unless the filter is frequently cleansed of the trapped PM, this increased work can lead to reductions in engine performance and increases in fuel consumption. This loss in performance may be noted by the equipment operator in terms of sluggish engine response.

Full field test evaluations and retrofit applications of these catalytic trap technologies are occurring in parts of the United States and Europe where low sulfur diesel fuel is already available.[217] The experience gained in these field tests helps to clarify the need for low sulfur diesel fuel. In Sweden and some European city centers where below 10 ppm diesel fuel sulfur is readily available, more than 3,000 catalyzed diesel particulate filters have been introduced into retrofit applications without a single failure. Given the large number of vehicles participating in these test programs, the diversity of the vehicle applications which included intercity trains, airport buses, mail trucks, city buses and garbage trucks, and the extended time periods of operation (some vehicles have been operating with traps for more than 5 years and in excess of 300,000 miles[218]), there is a strong indication of the robustness of this technology on 10 ppm low sulfur diesel fuel. The field experience in areas where sulfur is capped at 50 ppm has been less definitive. In regions without extended periods of cold ambient conditions, such as the United Kingdom, field tests on 50 ppm cap low sulfur fuel have also been positive, matching the durability at 10 ppm, although sulfate PM emissions are much higher. However, field tests on 50 ppm fuel in Finland, where colder winter conditions are sometimes encountered (similar to many parts of the United States), showed a significant number of failures (~10 percent) due to trap plugging. This 10 percent failure rate has been attributed to insufficient trap regeneration due to fuel sulfur in combination with low ambient temperatures.[219] Other possible reasons for the high failure rate in Finland when contrasted with the Swedish experience appear to be unlikely. The Finnish and Swedish fleets were substantially similar, with both fleets consisting of transit buses powered by Volvo and Scania engines in the 10 to 11 liter range. Further, the buses were operated in city areas and none of the vehicles were operated in northern extremes such as north of the Arctic Circle.[220] Given that the fleets in Sweden and Finland were substantially similar, and given that ambient conditions in Sweden are expected to be similar to those in Finland, we believe that

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[217] Through tax incentives 50 ppm cap sulfur fuel is widely available in the United Kingdom and 10 ppm sulfur fuel is available in Sweden and in certain European city centers.

[218] Allansson, et al., "European Experience of High Mileage Durability of Continuously Regenerating Filter Technology," SAE 2000-01-0480.

[219] Letter from Dr. Barry Cooper, Johnson Matthey, to Don Kopinski, US EPA. Copy available in EPA Air Docket A-2001-28.

[220] Telephone conversation between Dr. Barry Cooper, Johnson Matthey, and Todd Sherwood, EPA, Air Docket A-99-06.

the increased failure rates noted here are due to the higher fuel sulfur level in a 50 ppm cap fuel versus a 10 ppm cap fuel.[221]

Testing on an even higher fuel sulfur level of 200 ppm was conducted in Denmark on a fleet of 9 vehicles. In less than six months all of the vehicles in the Danish fleet had failed due to trap plugging.[222] The failure of some fraction of the traps to regenerate when operated on fuel with sulfur caps of 50 ppm and 200 ppm is believed to be primarily due to inhibition of the NO to NO_2 conversion as described here. Similarly the increasing frequency of failure with higher fuel sulfur levels is believed to be due to the further suppression of NO_2 formation when higher sulfur level diesel fuel is used. Since this loss in regeneration effectiveness is due to sulfur poisoning of the catalyst this real world experience would be expected to apply equally well to nonroad engines (i.e., operation on lower sulfur diesel fuel, 15 ppm versus 50 ppm, will increase regeneration robustness).

As shown above, sulfur in diesel fuel inhibits NO oxidation leading to increased exhaust backpressure and reduced fuel economy. Therefore, we believe that, in order to ensure reliable and economical operation over a wide range of expected operating conditions, nonroad diesel fuel sulfur levels should be at or below 15 ppm.

b. Loss of PM Control Effectiveness

In addition to inhibiting the oxidation of NO to NO_2, the sulfur dioxide (SO_2) in the exhaust stream is itself oxidized to sulfur trioxide (SO_3) at very high conversion efficiencies by the precious metals in the catalyzed particulate filters. The SO_3 serves as a precursor to the formation of hydrated sulfuric acid (H_2SO_4+H_2O), or sulfate PM, as the exhaust leaves the vehicle tailpipe. Virtually all of the SO_3 is converted to sulfate under dilute exhaust conditions in the atmosphere as well in the dilution tunnel used in heavy-duty engine testing. Since virtually all sulfur present in diesel fuel is converted to SO_2, the precursor to SO_3, as part of the combustion process, the total sulfate PM is directly proportional to the amount of sulfur present in diesel fuel. Therefore, even though diesel particulate filters are very effective at trapping the carbon and the SOF portions of the total PM, the overall PM reduction efficiency of catalyzed diesel particulate filters drops off rapidly with increasing sulfur levels due to the formation of sulfate PM downstream of the CDPF.

SO_2 oxidation is promoted across a catalyst in a manner very similar to the oxidation of NO, except it is converted at higher rates, with peak conversion rates in excess of 50 percent. The

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221 The average temperature in Helsinki, Finland, for the month of January is 21˚F. The average temperature in Stockholm, Sweden, for the month of January is 26˚F. The average temperature at the University of Michigan in Ann Arbor, Michigan, for the month of January is 24˚F. The temperatures reported here are from www.worldclimate.com based upon the Global Historical Climatology Network (GHCN) produced jointly by the National Climatic Data Center and Carbon Dioxide Information Analysis Center at Oak Ridge National Laboratory (ORNL).

222 Letter from Dr. Barry Cooper to Don Kopinski US EPA. Copy available in EPA Air Docket A-2001-28.

SO_2 oxidation rate for a platinum based oxidation catalyst typical of the type which might be used in conjunction with, or as a washcoat on, a CDPF can vary significantly with exhaust temperature. At the low temperatures the oxidation rate is relatively low, perhaps no higher than ten percent. However at the higher temperatures that might be more typical of agricultural tractor use pulling a plow and the highway Supplemental Emission Test (also called the EURO III or 13 mode test), the oxidation rate may increase to 50 percent or more. These high levels of sulfate make across the catalyst are in contrast to the very low SO_2 oxidation rate typical of diesel exhaust (typically less than 2 percent). This variation in expected diesel exhaust temperatures means that there will be a corresponding range of sulfate production expected across a CDPF.

The US Department of Energy in cooperation with industry conducted a study entitled DECSE to provide insight into the relationship between advanced emission control technologies and diesel fuel sulfur levels. Interim report number four of this program gives the total particulate matter emissions from a heavy-duty diesel engine operated with a diesel particulate filter on several different fuel sulfur levels. A straight line fit through this data is presented in Table III.F-1 below showing the expected total direct PM emissions from a diesel engine on the supplemental emission test cycle.[223] The SET test cycle, a 13 mode steady-state cycle, that this data was developed on is similar to the C1 eight mode steady-state nonroad test cycle. Both cycles include operation at full and intermediate load points at approximately rated speed conditions and torque peak speed conditions. As a result, the sulfate make rate for the C1 cycle and the SET cycle would be expected to be similar. The data can be used to estimate the PM emissions from diesel engines operated on fuels with average fuel sulfur levels in this range.

[223] Note that direct emissions are those pollutants emitted directly from the engine or from the tailpipe depending on the context in which the term is used, and indirect emissions are those pollutants formed in the atmosphere through chemical reactions between direct emissions and other atmospheric constituents.

TABLE III.F-1 -- ESTIMATED PM EMISSIONS FROM A DIESEL ENGINE AT THE INDICATED FUEL SULFUR LEVELS

	Steady State Emissions Performance	
Fuel Sulfur [ppm]	Tailpipe PM[b] [g/bhp-hr]	PM Increase Relative to 3 ppm Sulfur
3	0.003	--
7[a]	0.006	100%
15[a]	0.009	200%
30	0.017	470%
150	0.071	2300%

Notes
[a] The PM emissions at these sulfur levels are based on a straight-line fit to the DECSE data; PM emissions at other sulfur levels are actual DECSE data. (Diesel Emission Control Sulfur Effects (DECSE) Program - Phase II Interim Data Report No. 4, Diesel Particulate Filters-Final Report, January 2000. Table C1.) Although DECSE tested diesel particulate filters at these fuel sulfur levels, they do not conclude that the technology is feasible at all levels, but they do note that testing at 150 ppm is a moot point as the emission levels exceed the engine's baseline emission level.
[b] Total exhaust PM (soot, SOF, sulfate).

Table III.F-1 makes it clear that there are significant PM emission reductions possible with the application of catalyzed diesel particulate filters and low sulfur diesel fuel. At the observed sulfate PM conversion rates, the DECSE program results show that the 0.01 g/bhp-hr total PM standard is feasible for CDPF equipped engines operated on fuel with a sulfur level at or below 15 ppm. The results also show that diesel particulate filter control effectiveness is rapidly degraded at higher diesel fuel sulfur levels due to the high sulfate PM make observed with this technology. It is clear that PM reduction efficiencies are limited by sulfur in diesel fuel and that, in order to realize the PM emissions benefits sought in this rule, diesel fuel sulfur levels must be at or below 15 ppm.

c. Increased Maintenance Cost for Diesel Particulate Filters Due to Sulfur

In addition to the direct performance and durability concerns caused by sulfur in diesel fuel, it is also known that sulfur can lead to increased maintenance costs, shortened maintenance intervals, and poorer fuel economy for CDPFs. CDPFs are highly effective at capturing the inorganic ash produced from metallic additives in engine oil. This ash is accumulated in the filter and is not removed through oxidation, unlike the trapped soot PM. Periodically the ash must be removed by mechanical cleaning of the filter with compressed air or water. This maintenance step is anticipated to occur on intervals of well over 1,500 hours (depending on engine size). However, sulfur in diesel fuel increases this ash accumulation rate through the formation of metallic sulfates in the filter, which increases both the size and mass of the trapped ash. By increasing the ash accumulation rate, the sulfur shortens the time interval between the required maintenance of the filter and negatively impacts fuel economy.

2. Diesel NOx Catalysts and the Need for Low Sulfur Fuel

NOx adsorbers are damaged by sulfur in diesel fuel because the adsorption function itself is poisoned by the presence of sulfur. The resulting need to remove the stored sulfur (desulfate) leads to a need for extended high temperature operation which can deteriorate the NOx adsorber. These limitations due to sulfur in the fuel affect the overall performance and feasibility of the NOx adsorber technology.

a. Sulfur Poisoning (Sulfate Storage) on NOx Adsorbers

The NOx adsorber technology relies on the ability of the catalyst to store NOx as a metallic nitrate (MNO_3) on the surface of the catalyst, or adsorber (storage) bed, during lean operation. Because of the similarities in chemical properties of SOx and NOx, the SO_2 present in the exhaust is also stored by the catalyst surface as a sulfate (MSO_4). The sulfate compound that is formed is significantly more stable than the nitrate compound and is not released and reduced during the NOx release and reduction step (NOx regeneration step). Since the NOx adsorber is essentially 100 percent effective at capturing SO_2 in the adsorber bed, the sulfur build up on the adsorber bed occurs rapidly. As a result, sulfate compounds quickly occupy all of the NOx storage sites on the catalyst thereby rendering the catalyst ineffective for NOx storage and subsequent NOx reduction (poisoning the catalyst).

The stored sulfur compounds can be removed by exposing the catalyst to hot (over 650˚C) and rich (air-fuel ratio below the stoichiometric ratio of 14.5 to 1) conditions for a brief period.[224] Under these conditions, the stored sulfate is released and reduced in the catalyst.[225] While research to date on this procedure has been very favorable with regards to sulfur removal from the catalyst, it has revealed a related vulnerability of the NOx adsorber catalyst. Under the high temperatures used for desulfation, the metals that make up the storage bed can change in physical structure. This leads to lower precious metal dispersion, or "metal sintering," (a less even distribution of the catalyst sites) reducing the effectiveness of the catalyst.[226] This degradation of catalyst efficiency due to high temperatures is often referred to as thermal degradation. Thermal degradation is known to be a cumulative effect. That is, with each excursion to high temperature operation, some additional degradation of the catalyst occurs.

One of the best ways to limit thermal degradation is by limiting the accumulated number of desulfation events over the life of the vehicle. Since the period of time between desulfation

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[224] Dou, Danan and Bailey, Owen, "Investigation of NOx Adsorber Catalyst Deactivation," SAE 982594.

[225] Guyon, M. et al, "Impact of Sulfur on NOx Trap Catalyst Activity - Study of the Regeneration Conditions", SAE 982607.

[226] Though it was favorable to decompose sulfate at 800˚C, performance of the NSR (NOx Storage Reduction catalyst, i.e. NOx Adsorber) catalyst decreased due to sintering of precious metal. - Asanuma, T. et al, "Influence of Sulfur Concentration in Gasoline on NOx Storage -Reduction Catalyst", SAE 1999-01-3501.

events is expected to be determined by the amount of sulfur accumulated on the catalyst (the higher the sulfur accumulation rate, the shorter the period between desulfation events) the desulfation frequency is expected to be proportional to the fuel sulfur level. In other words for each doubling in the average fuel sulfur level, the frequency and accumulated number of desulfation events are expected to double. We concluded in the HD2007 rulemaking, that this thermal degradation would be unacceptable high for fuel sulfur levels greater than 15 ppm. Some commenters to the HD2007 rule suggested that the NOx adsorber technology could meet the HD2007 NOx standard using diesel fuel with a 30 ppm average sulfur level. This would imply that the NOx adsorber could tolerate as much as a four fold increase in desulfation frequency (when compared to an expected seven to 10 ppm average) without any increase in thermal degradation. That conclusion was inconsistent with our understanding of the technology at the time of the HD2007 rulemaking and remains inconsistent with our understanding of progress made by industry since that time. Diesel fuel sulfur levels must be at or below 15 ppm in order to limit the number and frequency of desulfation events. Limiting the number and frequency of desulfation events will limit thermal degradation and, thus, enable the NOx adsorber technology to meet the NOx standard.

This conclusion remains true for the highway NOx adsorber catalyst technology that this proposal is based upon and will be equally true for nonroad engines applying the NOx adsorber technology to comply with our proposed Tier 4 standards.

Nonroad and highway diesel engines are similarly durable and thus over their lifetimes consume a similar amount of diesel fuel. This means that both nonroad and highway diesel engines will have the same exposure to sulfur in diesel fuel and thus will require the same number of desulfation cycles over their lifetimes. This is true independent of the test cycle or in-use operation of the nonroad engine.

Sulfur in diesel fuel for NOx adsorber equipped engines will also have an adverse effect on fuel economy. The desulfation event requires controlled operation under hot and net fuel rich exhaust conditions. These conditions, which are not part of a normal diesel engine operating cycle, can be created through the addition of excess fuel to the exhaust. This addition of excess fuel causes an increase in fuel consumption.

Future improvements in the NOx adsorber technology, as we have observed in our ongoing diesel progress reviews, are expected and needed in order to meet the NOx emission standards proposed today. Some of these improvements are likely to include improvements in the means and ease of removing stored sulfur from the catalyst bed. However because the stored sulfate species are inherently more stable than the stored nitrate compounds (from stored NOx emissions) and so will always be stored preferentially to NOx on the adsorber storage sites, we expect that a separate release and reduction cycle (desulfation cycle) will always be needed in order to remove the stored sulfur. Therefore, we believe that fuel with a sulfur level at or below 15 ppm sulfur will be necessary in order to control thermal degradation of the NOx adsorber catalyst and to limit the fuel economy impact of sulfur in diesel fuel.

b. Sulfate Particulate Production and Sulfur Impacts on Effectiveness of NOx Control Technologies

The NOx adsorber technology relies on a platinum based oxidation function in order to ensure high NOx control efficiencies. As discussed more fully in Section III.F.1, platinum based oxidation catalysts form sulfate PM from sulfur in the exhaust gases significantly increasing PM emissions when sulfur is present in the exhaust stream. The NOx adsorber technology relies on the oxidation function to convert NO to NO_2 over the catalyst bed. For the NOx adsorber this is a fundamental step prior to the storage of NO_2 in the catalyst bed as a nitrate. Without this oxidation function the catalyst will only trap that small portion of NOx emissions from a diesel engine which is NO_2. This would reduce the NOx adsorber effectiveness for NOx reduction from in excess of 90 percent to something well below 20 percent. The NOx adsorber relies on platinum to provide this oxidation function due to the need for high NO oxidation rates under the relatively cool exhaust temperatures typical of diesel engines. Because of this fundamental need for a precious metal catalytic oxidation function, the NOx adsorber inherently forms sulfate PM when sulfur is present in diesel fuel, since sulfur in fuel invariably leads to sulfur in the exhaust stream.

The Compact-SCR technology, like the NOx adsorber technology, uses an oxidation catalyst to promote the oxidation of NO to NO_2 at the low temperatures typical of much of diesel engine operation. By converting a portion of the NOx emissions to NO_2 upstream of the ammonia SCR reduction catalyst, the overall NOx reductions are improved significantly at low temperatures. Without this oxidation function, low temperature SCR NOx effectiveness is dramatically reduced making compliance with the NOx standard impossible. Therefore, future Compact-SCR systems would need to rely on a platinum oxidation catalyst in order to provide the required NOx emission control. This use of an oxidation catalyst in order to enable good NOx control means that Compact SCR systems will produce significant amounts of sulfate PM when operated on anything but the lowest fuel sulfur levels due to the oxidation of SO_2 to sulfate PM promoted by the oxidation catalyst.

Without the oxidation catalyst promoted conversion of NO to NO_2, neither of these NOx control technologies can meet the proposed NOx standard. Therefore, each of these technologies will require low sulfur diesel fuel to control the sulfate PM emissions inherent in the use of highly active oxidation catalysts. The NOx adsorber technology may be able to limit its impact on sulfate PM emissions by releasing stored sulfur as SO_2 under rich operating conditions. The Compact-SCR technology, on the other hand, has no means to limit sulfate emissions other than through lower catalytic function or lowering sulfur in diesel fuel. The degree to which the NOx emission control technologies increase the production of sulfate PM through oxidation of SO_2 to SO_3 varies somewhat from technology to technology, but it is expected to be similar in magnitude and environmental impact to that for the PM control technologies discussed previously, since both the NOx and the PM control catalysts rely on precious metals to achieve the required NO to NO_2 oxidation reaction.

At fuel sulfur levels below 15 ppm this sulfate PM concern is greatly diminished. Without this low sulfur fuel, the NOx control technologies are expected to create PM emissions well in excess of the PM standard regardless of the engine-out PM levels. Thus, we believe that diesel fuel sulfur levels will need to be at or below 15 ppm in order to apply the NOx control technology.

G. Reassessment of Control Technology for Engines Less Than 75 hp in 2007

By structuring our program to benefit extensively from prior experience with core technologies in the highway sector, we believe that a nonroad diesel technology review of the extent being pursued for the heavy-duty highway engine program will not be needed.[227] Indeed the results of that ongoing review have already had a very helpful impact in shaping this proposal. Nevertheless, there are some technology issues that will not be addressed in the highway program review. In particular we believe that a future review of particulate filter technology for engines under 75 hp may be warranted. Under our proposed schedule presented in Section III.B, standards based on the performance of this technology will take effect in the 2013 model year for 25-75 hp engines (or in the 2012 model year for manufacturers opting to skip the transitional standards for 50-75 hp engines).

At this time we have not decided what the long-term PM standards should be for engines under 25 hp. No PM filter-based standards are being proposed for engines under 25 hp as part of this Tier 4 proposal. Likewise, we have not decided what the long-term NOx standards should be for engines under 75 hp, and no NOx adsorber-based standards are being proposed for engines under 75 hp. As part of the technology review, we plan to thoroughly evaluate progress made toward applying advanced PM and NOx control technologies to these smaller engines.

We propose to conduct the technology review in 2007, and to conclude it by the end of that year, to give manufacturers lead time should an adjustment in the program be considered appropriate. We do not intend to include in the technology review a reassessment of PM filter technology needed to meet the optional 0.02 g/hp-hr PM standard for 50-75 hp engines in 2012. We assume that manufacturers would only choose this option if they had confidence that they could meet the 0.02 g/hp-hr standard in 2012, a year earlier than otherwise required.

We recognize the importance of harmonization of international standards and have worked diligently with our colleagues in Europe and Japan to achieve that objective. Harmonization of these standards will allow manufacturers continued access to world markets and lower the required research and development and tooling costs needed to meet different standards. We will continue to work with both governments and the manufacturers abroad and within the United States. We have incorporated feedback from the on-going dialogue and have continued to work through the international process as we have developed this proposal. The Commission has proposed amendments in December 2002 to EC Directive 97/68 which are currently being addressed in the European Council and Parliament. We believe that today's proposal and the European approach together provide the framework for additional harmonization. While not identical, manufacturers have expressed appreciation for the similarities which do exist and they

[227] See "Highway Diesel Progress Review", U.S. EPA, June 2002. EPA420-R-02-016. (www.epa.gov/air/caaac/dieselreview.pdf).

represent a significant step toward mitigating the differences in design challenges that would otherwise exist. The limit values and test procedures provide a basis for common development which manufacturers can use on a global basis. The amendments would control fuel sulfur levels to enable aftertreatment, set nonroad mobile machine emissions limits that would be based on performance of diesel particulate traps. NOx limits are being set to match the Agency's Tier 3 NOx program. There are a few differences in approaches that we will continue to discuss with the EU. One difference is that the EC has chosen a leadtime for trap-based PM standards for engines in the 50-100 hp range which is one year earlier than we are proposing today. Another difference is the inclusion of a review of the availability of NOx emission control technology for larger engines. The EC has also chosen not to set performance requirements that would require the use of PM traps for engines under 50 hp, while we are proposing performance-based standards that would likely require the use of PM traps for engines between 25-75 hp. The EC has again chosen not to set standards for engines below 19 kW (25 hp) and greater than 560 kW (750 hp). With respect to long term NOx control, the Commission has chosen to have a technology review (which would also reassess issues related to PM) to address implementing potentially more stringent NOx standards in the same timeframe as potential EPA standards.[228] For additional information about the harmonization effort and the results to date, please see Chapter 2.4.2 of the SBREFA panel report. We request comment on opportunities to further enhance harmonization.

We expect that any changes to the level or timing of emission standards found appropriate in the 2007 review would be made as part of a rulemaking process, and that process would take additional time after the review is completed. If the 2007 review should determine that PM trap technology is feasible for engine under 25 hp, or that advanced NOx control technology is feasible for engines under 75 hp, or that Tier 4 standards should be made more stringent in some other way, we would expect the rulemaking implementing such changes to provide for adequate lead time. Therefore, it would be premature for us to target 2013 or any specific model year for implementing such standards changes at this time. We solicit comment on the scope, timing, and need for a future reassessment of emissions control technology for nonroad diesel engines.

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[228] Commission of the European Communities, "Proposal for a Directive of the European Parliament and of the Council amending Directive 97/68/EC", Section 3.9.

IV. Our Proposed Program for Controlling Nonroad, Locomotive and Marine Diesel Fuel Sulfur

We are proposing to reduce the sulfur content of nonroad, locomotive and marine (NRLM) diesel fuel to no more than 500 ppm beginning in 2007. We are also proposing to reduce the sulfur content of nonroad diesel fuel to no more than 15 ppm beginning in 2010. These provisions mirror controls on highway diesel fuel to 500 ppm in 1993[229] and 15 ppm in 2006.[230]

There are two reasons that we are proposing these standards. First, fuel sulfur significantly inhibits or impairs the function of the diesel exhaust emission control devices, which would generally be necessary to meet the proposed nonroad diesel engine emission standards. In conjunction with the proposed 15 ppm sulfur standard for nonroad diesel fuel we have concluded that this emission control technology will be available to achieve the reductions required by the stringent NOx and PM emission standards proposed for model year 2011 and later nonroad diesel engines. Second, sulfur in diesel fuel is emitted from the engine as sulfate PM and sulfur dioxide, both of which cause adverse health and welfare impacts, as described in Section II. above. Reducing the level of sulfur in diesel fuel to 500 ppm beginning in 2007 would achieve important emission reductions of these pollutants and provide significant public health and welfare benefits. The further reduction to 15 ppm in 2010 will expand upon these benefits.

In developing the proposed diesel fuel program, we identified several principles that we wanted the program to achieve:

1) Maintain the benefits and program integrity of the highway diesel fuel program;

2) Achieve the greatest reduction in sulfate PM and sulfur dioxide emissions from nonroad, locomotive, and marine diesel engines as early as practicable;

3) Provide for a smooth transition of the nonroad diesel fuel pool to 15 ppm sulfur;

4) Ensure that 15 ppm sulfur diesel fuel is produced and distributed widely for use in all 2011 and later model year nonroad engines;

5) Enable the efficient distribution of all diesel fuels; and

6) Ensure that the program's requirements are enforceable and verifiable.

As described below, we believe the proposed fuel program achieves these principles.

The remainder of this section is organized as follows:

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229 55 FR 34120 (August 21, 1990).

230 66 FR 5002 (January 18, 2001).

A) The fuel standards proposed today,
B) The design and structure of the fuel program,
C) Special hardship provisions proposed for small refiners and refiners facing particularly difficult circumstances,
D) Special provisions proposed for fuel sold in the State of Alaska and U.S. Territories,
E) The affect of the proposed program on state diesel fuel control programs,
F) The technological feasibility of the production and distribution of 500 ppm and 15 ppm sulfur nonroad, locomotive and marine diesel fuel,
G) The impact of the program on other fuel properties and specialty fuels, and
H) The need for some refiners to obtain air permits for their desulfurization equipment.

Analyses supporting the design of these provisions can be found in Chapter V and VII of the Draft RIA for today's action. Section VIII of this preamble provides a discussion of the compliance and enforcement provisions affecting diesel fuel and additional explanation of various elements of the proposed program.

A. Proposed Nonroad, Locomotive and Marine Diesel Fuel Quality Standards

The following paragraphs describe the requirements, standards, and deadlines that apply to refiners, importers, and distributors of nonroad, locomotive and marine (NRLM) diesel fuel and the options available to all refiners.

1. What Fuel Is Covered by this Proposal?

The proposed standards generally cover all the diesel fuel that is used in mobile applications but is not already covered by the previous standards for highway diesel fuel. This fuel is defined primarily by the type of engine which it is used to power: nonroad, locomotive, and marine diesel engines. These fuels typically include:

1) Any number 1 and 2 distillate fuels used, intended for use, or made available for use in nonroad, locomotive or marine diesel engines,
2) Any number 1 distillate fuel (e.g., kerosene) added to such number 2 diesel fuel, e.g., to improve its cold flow properties, and
3) Any other fuel used in or blended with diesel fuel for use in nonroad, locomotive, or marine diesel engines that has comparable chemical and physical characteristics.

Primary examples of fuels under 1) would be those meeting ASTM D975 or D396 specifications for grades number 1-D and number 2-D or ASTM DMX and DMA specifications, if used in the engines mentioned above. Primary examples under 3) would be certain specialty fuels grades such as JP-5, JP-8, and F76 if used in nonroad, locomotive, or marine equipment for which a national security exemption has not been approved (See Section VIII.A.2) and non-distillate fuels such as biodiesel.

This proposal would not apply to:

1) Number 1 distillate fuel used to power jet aircraft,
2) Number 1 or number 2 distillate fuel used for other purposes, such as to power stationary diesel engines or for heating,
3) Number 4 and 6 fuels (e.g., bunker or residual fuels, IFO Heavy Fuel Oil Grades 30 and higher, ASTM DMB and DMC fuels), and
4) Any fuel used to power equipment for which a national security exemption has been approved (see Section VIII.A.2).

The proposed program would reduce the sulfur in all diesel fuel likely used in mobile off-highway equipment and achieve very significant short and long-term environmental benefits. States, not the Agency, have responsibility for any fuel sulfur specifications for heating oil, so this fuel would not be covered by this proposal.[231] However, we do propose a number of provisions, as described below, that would ensure that heating oil would not be used in nonroad, locomotive, or marine applications.

As in the recent highway diesel rule, in those cases where the same batch of kerosene is distributed for two purposes (e.g., as kerosene to be used for heating and to improve the cold flow of number 2 nonroad diesel fuel), that batch of kerosene would have to meet the standards being proposed today for nonroad diesel fuel. However, an alternative compliance approach would be to produce and distribute two distinct kerosene fuels. In our example above, one batch would meet the proposed sulfur standards and could be blended into number 2 NRLM diesel fuel. The other batch would only have to meet any applicable specifications for heating oil.

2. Standards and Deadlines for Refiners, Importers, and Fuel Distributors

The proposed fuel program consists of a two-step program to reduce the sulfur content of nonroad diesel fuel. By doing so, the program would allow the refining industry to smoothly transition the sulfur content from its current uncontrolled levels down to the very stringent 15 ppm level. By beginning with an initial step down to 500 ppm, we can start to achieve significant emission reductions and associated health and welfare benefits from the current fleet of equipment as soon as possible. While we considered and are seeking comment on a one-step approach of going directly to 15 ppm in 2008, as discussed in Section VI, we believe that on balance the advantages of the proposed two-step approach outweigh those of a single step.

[231] For the purposes of this proposal, the term heating oil refers to any number 1 or number 2 distillate other than jet fuel and diesel fuel used in highway, nonroad, locomotive, or marine applications. For example, heating oil includes fuel which is suitable for use in furnaces, boilers, stationary diesel engines and similar applications and is commonly or commercially known or sold as heating oil, fuel oil, and other similar trade names.

The specific proposed deadlines for meeting the 500 and 15 ppm sulfur standards would not apply to refineries covered by special hardship provisions for small refiners. In addition, a different schedule would apply for any refineries approved under the proposed general hardship provisions. All of these hardship provisions are described below in Section IV.C.

a. The First Step to 500 ppm

Under this proposal NRLM diesel fuel produced by refiners or imported into the U.S. would be required to meet a 500 ppm sulfur standard beginning June 1, 2007. Refiners and importers could comply by either producing such fuel at or below 500 ppm, or could comply by obtaining credits as discussed in Section B below.

We believe that the proposed level of 500 ppm is appropriate for several reasons. This 500 ppm level is consistent with current highway diesel fuel, a grade which may remain for highway purposes until 2010. As such, adopting the same 500 ppm level for NRLM helps to avoid any issues and costs associated with more grades of fuel in the distribution system during this initial step of the program. The reduction to 500 ppm is also significant environmentally. The 500 ppm level achieves approximately 90 percent of the sulfate PM and SO_2 benefits otherwise achievable by going all the way to 15 ppm. Yet, the costs would be roughly half that associated with full control down to 15 ppm. Because this first step is only to 500 ppm, it also allows for a short lead time for implementation, enabling the environmental benefits to begin accruing as soon as possible. After careful analysis of feasibility as discussed in Section IV.F.5, we believe that the proposed start date of June 1, 2007 is the earliest that the 500 ppm step could take effect.

To allow for the enforcement of the proposed fuel standards while at the same time allowing for a smooth and orderly transition of diesel fuel in the distribution system to 500 ppm, we are proposing that parties downstream of the refineries be allowed time to turnover their NRLM tanks to 500 ppm. We are proposing that at the terminal level, NRLM diesel fuel would be required to meet the 500 ppm sulfur standard beginning August 1, 2007. At bulk plants, wholesale purchaser-consumers, and any retail stations carrying NRLM diesel, this fuel would have to meet the 500 ppm sulfur standard by October 1, 2007.[232] The only exceptions to these dates would be for high sulfur NRLM produced under the hardship and fuel credit provisions discussed below in Sections IV.B. and C.[233]

[232] A bulk plant is a secondary distributor of refined petroleum products. They typically receive fuel from terminals and distribute fuel in bulk by truck to end users. Consequently, while for highway fuel, bulk plants often serve the role of a fuel distributor, delivering fuel to retail stations, for nonroad fuel, they often serve the role of the retailer, delivering fuel directly to the end-user.

[233] Furthermore, as discussed in subsection B, we propose that high sulfur nonroad diesel fuel which is produced after June 1, 2007 due to the small refiner and fuel credit provisions could be commingled with 500 ppm nonroad diesel fuel after it has been dyed to the IRS specifications. Thus, at some points in the distribution system, nonroad fuel higher than the 500 ppm standard would remain until it is precluded from production beginning June 1, 2010.

This downstream turnover schedule is slightly more relaxed than for the second step to 15 ppm discussed below. This first step down to 500 ppm is designed to achieve the public health and welfare benefits from reduced emissions in the current fleet of engines. Since the sulfate PM and SO2 benefits accrue as the fuel is desulfurized to any degree, mixing in the distribution system during the transition to 500 ppm would not reduce this benefit or cause any adverse consequences. Mixing in the distribution system would also not reduce the engine performance and durability benefits from the reduction in sulfur. As a result, the immediate turnover of the fuel pool downstream of the refinery gate is of less concern and a more relaxed schedule than described below for the second step is possible. We seek comment on this proposed schedule.

b. The Second Step to 15 ppm

In order to enable the application of high efficiency exhaust emission control technologies to nonroad diesel engines beginning with the 2011 model year, we are proposing that all nonroad diesel fuel produced or imported after June 1, 2010 would have to meet a 15 ppm sulfur cap. We are proposing that diesel fuel used for locomotive and marine diesel engines could continue to the meet the 500 ppm cap first applicable in 2007.

In order to allow for a smooth and orderly transition of diesel fuel in the distribution system to 15 ppm, we are proposing that parties downstream of the refineries be allowed some additional time to turnover their tanks to 15 ppm. We are proposing that at the terminal level, nonroad diesel fuel would be required to meet the 15 ppm sulfur standard beginning July 15, 2010. At bulk plants, wholesale purchaser-consumers, and any retail stations carrying nonroad diesel, this fuel would have to meet the 15 ppm sulfur standard by September 1, 2010. The proposed transition schedule for compliance with the 15 ppm standard at refineries, terminals, and secondary distributors is the same as that allowed under the recently promulgated highway diesel fuel program.

As with the 500 ppm standard, refiners and importers could comply with this standard by either physically producing 15 ppm fuel or by obtaining sulfur credits, as described below.

We are seriously considering bringing the sulfur level of locomotive and marine diesel fuel to 15 ppm as early as June 1, 2010 along with nonroad diesel fuel. As discussed in more detail in Section VI and in Chapter 12 of the draft RIA, there are several advantages associated with this alternative. First, it would provide important sulfate PM and SO2 emission reductions and the estimated benefits from these reductions would outweigh the costs by a considerable margin. Second, it would simplify the fuel distribution system and the design of the fuel program proposed today. Third, it would help reduce the potential opportunity for misfueling of 2007 and later model year highway vehicles and 2011 and later model year nonroad equipment with higher sulfur fuel. Finally, it would allow refiners to coordinate plans to reduce the sulfur content of all of their nonroad diesel fuel at one time.

However, discussions with refiners have suggested there are advantages to leaving locomotive and marine diesel fuel at 500 ppm, at least in the near-term and until we set more stringent standards for those engines. The locomotive and marine diesel fuel markets could provide a market for off-spec product which is important for refiners, particularly during the transition to 15 ppm for highway and nonroad diesel fuel in 2010. Waiting just a year or two beyond 2010 would address the critical near term needs during the transition. Second, waiting just another year or two beyond 2010 is also projected to allow virtually all refiners to take advantage of the new lower cost technology.

In addition to seeking comment on whether to apply the 15 ppm standard to locomotive and marine diesel fuel in 2010, we also seek comment on other timing for doing so, and especially on how the Agency should coordinate a 15 ppm standard for locomotive and marine with the nonroad diesel fuel standard being proposed today. It is the Agency's intention to propose in the near future new emission standards for locomotive and marine engines that could require the use of high efficiency exhaust emission control technology, and thus, also require the use of 15 ppm sulfur diesel fuel. We anticipate that such engine standards would likely take effect in the 2011-13 time frame, requiring 15 ppm locomotive and marine diesel fuel in the 2010-12 time frame. We intend to publish an advanced notice of proposed rulemaking (ANPRM) for such a rule in the Spring of 2004 and complete action on a final rule by 2007.

c. Other Standard Provisions

We are proposing that the 500 ppm NRLM and 15 ppm nonroad diesel fuel standards would apply to the areas of Alaska served by the Federal Aid Highway System (FAHS). Rural areas, those outside the FAHS, would not be subject to either the 15 or 500 ppm standards. Market forces in these areas would be relied upon to provide 15 ppm diesel fuel for 2011 and later nonroad diesel engines used in these areas. This is consistent with the approach which is in the process of being developed by the State of Alaska for implementing the 2007 highway diesel fuel program. EPA can revisit this issue when it takes action on Alaska's plan for implementation of the highway sulfur requirements, allowing for coordination of the nonroad and highway fuel requirements. The specifics of our proposal for diesel fuel sold in Alaska are described in more detail in Section IV.D.1. below. In addition, these proposed 500 and 15 ppm sulfur caps would not apply to diesel fuel sold in three Pacific U.S. territories, as described in more detail in Section IV.D.2. below.

The early credits and other special provisions create the probability that high sulfur NRLM diesel fuel would be produced and sold after June 1, 2007 and that 500 ppm nonroad diesel fuel would be produced and sold after June 1, 2010. Under the proposal, fuel distributors would be responsible for ensuring the necessary product segregations and that statements on product transfer documents and fuel product labels are consistent with the corresponding fuel quality. The specific requirements for both fuel distributors and end-users are described in detail in Section VIII.

d. Cetane Index or Aromatics Standard

Currently, in addition to containing no more than 500 ppm sulfur, EPA requires that highway diesel fuel meet a minimum cetane index level of 40 or, as an alternative contain no more than 35 volume percent aromatics. We are proposing today to extend this cetane index/aromatics content specification to NRLM diesel fuel. Extension of these content specifications would reduce NOx and PM emissions from the current nonroad equipment fleet slightly, providing associated public health and welfare benefits.

Low diesel fuel cetane levels are associated with increases in NOx and PM emissions in current nonroad diesel engines. Thus, we expect that this cetane index specification would lead to a reduction in these emissions from the existing fleet. Because the vast majority of current NRLM diesel fuel already meets this specification, the NOx and PM emission reductions would be small. Also, the impact of cetane on NOx and PM emissions appears to be very weak or nonexistent for diesel engines equipped with EGR. Thus, the positive emission impact of this specification would likely decrease over time as these engines gradually dominate the in-use fleet.

ASTM already applies a cetane number specification of 40 to NRLM diesel fuel, which in general is more stringent than the similar 40 cetane index specification. Because of this, the vast majority of current NRLM diesel fuel already meets the EPA cetane index/aromatics specification for highway diesel fuel. Thus, the proposed requirement would have an actual impact only on a limited number of refiners and there would be little overall cost associated with producing fuel to meet the proposed cetane/aromatic requirement. In fact, as discussed in section 5.9 of the draft RIA, complying with the sulfur standards proposed today is expected to result in a small cetane increase, leaving little or no further control to meet the standard.

In addition, we expect that if all NRLM fuel met the cetane index or aromatics specification as proposed, refiners would benefit from the ability to fungibly (mixed together) distribute highway and NRLM diesel fuels of like sulfur content. For that fraction of fuel that today does not meet this specification, the proposed requirement would eliminate the need to separately distribute fuels of different cetane/aromatics specifications that would otherwise need to occur. Requiring NRLM diesel fuel to meet this cetane index specification would thus give fuel distributors certainty in being able to combine shipments of highway and NRLM diesel fuels. Overall, we believe that the economic benefits from more efficient fuel distribution would likely exceed the cost of refining the small volume of NRLM diesel fuel that might not currently meet the cetane index or aromatics content specification.

We request comment on the costs and benefits of our proposal to extend the cetane index and alternative aromatics standard applicable to highway diesel fuel to NRLM diesel fuel.

B. Program Design and Structure

In addition to the proposed content standards and their timing, the program must be designed and structured carefully to achieve the overall principles of this proposed nonroad diesel fuel program. The health and welfare benefits and the need for widespread availability of 15 ppm highway diesel fuel must be maintained. This will only happen if the program is designed such that the amount of low sulfur fuel expected to be produced under the highway diesel program is in fact produced. Likewise, the benefits of the low sulfur diesel program proposed today will only be achieved if the program is designed such that the volume of diesel fuel consumed by NRLM engines is matched by the production and distribution of at least the same volume of diesel fuel produced to the appropriate low sulfur levels. At the same time, promoting the efficiency of the distribution system calls for fungible distribution of physically similar products, and minimizing the need for segregation of products in the distribution system.

1. Background

Prior to the highway diesel sulfur standard that took effect in 1993, most number 2 distillate fuel was produced to essentially the same specifications, shipped fungibly, and used interchangeably for highway diesel engines, nonroad diesel engines, locomotive and marine diesel engines and heating oil applications. Beginning in 1993, highway diesel fuel was required to meet a 500 ppm sulfur cap and was segregated from other distillate fuels as it left the refinery by the use of a visible level of dye solvent red 164 in all non-highway distillate.[234] At about the same time, the IRS similarly required non-highway diesel fuel to be dyed red to a much higher concentration prior to retail sale to distinguish it from highway diesel fuel for excise tax purposes. Dyed non-highway fuel is exempt from this tax. This splitting of the distillate pool necessitated changes in the distribution system to ship and store the now distinct products separately. In some parts of the country where the costs to segregate non-highway diesel fuel from highway diesel fuel could not be justified, both fuels have been produced to the highway specifications.[235]

This proposal would set new specifications for nonroad, locomotive, and marine diesel fuel. However, currently there is no grade of diesel fuel which is produced and marketed as a distinguishable grade for NRLM uses. It is typically produced and shipped fungibly with other distillate used for heating oil purposes, and it is all dyed red in accordance with EPA and IRS regulations. Therefore, in order to control the sulfur content of NRLM, but not heating oil, this proposal requires some means of distinguishing fuel used for the two purposes. This is similar to the situation faced in 1993 in the case of highway diesel fuel. The solution in 1993 for highway diesel fuel was to dye the non-highway distillate. As discussed below, a similar approach is proposed today to identify and distinguish heating oil from NRLM.

This proposal would control the sulfur level of NRLM diesel fuel to 500 ppm in 2007, the same level currently applicable to highway diesel fuel, and the same level as up to 20 percent of the highway diesel fuel pool from June 1, 2006 through December 31, 2009. Under the current provisions of the highway diesel rule, this 500 ppm nonroad diesel fuel would have to be dyed red at the refinery gate and distributed separately from 500 ppm highway diesel fuel.

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[234] Non-highway distillate for the purposes of this proposal refers to all diesel fuel and distillate used for nonroad, locomotive, marine and heating oil purposes; in other words, all number 1 or number 2 distillate other than that used for highway purposes, and excluding jet fuels.

[235] Diesel fuel produced to highway specifications but used for non-highway purposes is referred to as "spill-over." It leaves the refinery gate and is fungibly distributed as if it were highway diesel fuel, and is typically dyed at a point later in the distribution system. Once it is dyed it is no longer available for use in highway vehicles, and is not part of the supply of highway fuel. Based on the most recent EIA data, roughly 15 percent of fuel produced to highway specifications is spillover, representing nearly a third of non-highway consumption.

Continuing to implement this dye provision would allow for simple enforcement of both the proposed NRLM standard and the more stringent highway standards during this timeframe. Clear, undyed diesel fuel would have to meet the 80/20 ratio of 15 ppm and 500 ppm applicable to highway fuel, and diesel fuel (dyed red) would have to meet the 500 ppm standard applicable to NRLM. Continuing the current dye provisions would therefore ensure that the intended benefits of both programs were achieved.. However, maintaining this dye distinction would also require segregation of a new grade of diesel fuel, 500 ppm NRLM, throughout the entire distribution system. The costs of requiring segregation of two otherwise identical fuels throughout the entire distribution system could be quite substantial.[236]

In order to avoid adding unnecessary cost to the fuel distribution system, we are proposing that the current requirement that non-highway distillate fuels be dyed at the refinery gate be made voluntary effective June 1, 2006.[237] However, in its place we are proposing an alternate means for refiners to differentiate their highway diesel fuel from NRLM diesel fuel (see IV.B.3 below). Where it is feasible and cost effective to continue to dye and segregate their nonroad fuel, we propose that refiners and importers may continue this option.

Since 500 ppm highway and NRLM diesel fuel would physically be the same, without some means of differentiating highway diesel fuel from NRLM diesel fuel, it would be impossible to maintain the benefits and program integrity of the 2006 highway diesel fuel program. Pre-2007 model year highway vehicles are free to continue using 500 ppm fuel until 2010 as long as it is available. However, if a refiner produced all 500 ppm fuel, designating it as nonroad fuel, that refiner would have no obligation to produce any 15 ppm highway diesel fuel. Without an effective way of limiting the use in the highway market of 500 ppm diesel fuel produced as NRLM fuel (provided currently by the refinery gate dye requirement), much more 500 ppm fuel could, and likely would find its way into the highway market than would otherwise happen under the current highway program, displacing 15 ppm that would have otherwise been produced. This likely series of events would circumvent the 80/20 intent of the highway rule and sacrifice some of the resulting PM and SO2 emission benefits of that program. Perhaps more importantly, if this occurred to any significant degree, it could also undermine the integrity of the highway program by failing to ensure adequate availability of 15 ppm fuel nationwide for the vehicles that need it.

2. Proposed Fuel Program Design and Structure

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[236] Under the highway program the potential exists to add a third grade of diesel fuel in an estimated 40% of the country, and we projected one-time tankage and distribution system costs of $1.05 billion to accomplish this. Using similar assumptions, to add a second 500 ppm grade nationwide would cost in excess of $2 billion. This assumes that the capability exists to add such new tankage.

[237] The IRS requirements concerning dyeing of non-highway fuel prior to sale to consumers are not changed by this rulemaking.

a. Program Beginning June 1, 2007

To avoid the costs associated with segregating 500 ppm NRLM diesel fuel from 500 ppm highway fuel, we propose that the existing requirement that NRLM diesel fuel be dyed leaving the refinery would be made voluntary. We propose that this change could occur as early as June 1, 2006. In its place we propose that a baseline volume percentage of non-highway diesel fuel would be established and enforced for each refinery and importer. The baseline percentage would be based on a historical average for a refinery or importer. The baseline percentage of non-highway diesel fuel would then be used to identify the amount of 500 ppm diesel fuel produced by that refinery or importer that is subject to the NRLM requirements and the amount of 500 ppm fuel is subject to the highway requirements. As detailed below, in conjunction with a marker to prevent the use of heating oil in nonroad equipment, the baseline percentage would effectively protect the benefits and integrity of the highway program, ensure that the benefits of the first step of NRLM diesel fuel to 500 ppm sulfur would be obtained, and would enable the efficient, fungible distribution of like grades of fuel. A discussion of this proposal follows, beginning with the introduction of a fuel marker for heating oil.

i. Use of A Marker to Differentiate Heating Oil from NRLM

If all NRLM diesel fuel were required to meet the 500 ppm standard beginning June 1, 2007, then heating oil and NRLM diesel fuel could be differentiated merely on the basis of their sulfur levels. However, this proposal would allow the limited production of high-sulfur NRLM fuel by small refiners, and by other refiners through the use of credits between 2007 and 2010 (see Section IV.B.2.b). To ensure that the only high sulfur diesel fuel used in nonroad, locomotive, and marine diesel engines is high sulfur NRLM and not heating oil, it would be necessary for parties in the distribution system, and for EPA, to be able to distinguish heating oil from high-sulfur NRLM diesel fuel. One way of ensuring that these fuels remain segregated in the distribution system would be to require that either a dye or a marker be added to heating oil to distinguish it from NRLM diesel fuel during the period of 2007 through 2010.[238] There is no differentiation today between fuel used for NRLM uses and heating oil. Both are typically produced to the same sulfur specification today, and both are required to have the same red dye added prior to distribution and sale.[239] As a result, the dye or marker would have to be different from the current red dye requirement.

There are a number of types of dyes and markers. Visible dyes are most common, are inexpensive, and are easily detected. Invisible markers are beginning to see more use in branded fuels and are somewhat more expensive than visible markers. Such markers are detected either by the addition of a chemical reagent or by their fluorescence when subjected to near-infra-red or ultraviolet light. Some chemical-based detection methods are suitable for use in the field. Others

[238] A marker is an additive which is phosphorescent or has some other property which allows it to be easily detected, though not necessarily visible to the naked eye. A dye is intended to be visibly identified by the naked eye.

[239] There may be some exceptions where a refiner produces a unique grade of distillate fuel solely for heating oil purposes.

must be conducted in the laboratory due to the complexity of the detection process or concerns regarding the toxicity of the reagents used to reveal the presence of the marker. Near-infra-red and ultra-violet flourescent markers can be easily detected in the field using a small device and after brief training of the operator. There are also more exotic markers available such as those based on immunoassay, and isotopic or molecular enhancement. Such markers typically need to be detected by laboratory analysis.

Using a second dye for segregation of heating oil based on visual identification raises certain challenges. Most dye colors that provide a strong visible trace in fuels are already in use for different fuel applications. More importantly, mixing two fuels containing different strong dyes can result in interference between the two dyes rendering identification of the presence of either dye difficult. Yet, the mixing of NRLM diesel fuel into heating oil for eventual sale as heating oil would be an acceptable and often an economically desirable practice. Furthermore, to avoid interfering with the IRS tax code, it would be advantageous to maintain the current red color. Based on these considerations, the best approach to prevent the use of heating oil as NRLM diesel fuel would appear to be requiring the addition to heating oil of either a dye that does not impart a significant color to diesel fuel or a marker that imparts no color at all. The dye or marker would be added at the refinery gate, just as visible evidence of the red dye is required today. Fuel containing the marker would be segregated from highway and NRLM diesel fuel and would be prohibited from use in highway, nonroad, locomotive, or marine application.

Effective in August 2002, the European Union (EU) enacted a marker requirement for diesel fuel that is taxed at a lower rate (which applies in all of the EU member states).[240] The marker selected by the EU is N-ethyl-N-[2-[1-(2-methylpropoxy)ethoxyl]-4-phenylazo]-benzeneamine.[241] This compound is also referred to as solvent yellow 124 or the Euromarker. We propose that beginning June 1, 2007 solvent yellow 124 must be added to heating oil in the U.S. We propose that it be added in a concentration of 6 milligrams per liter, the same treatment rate as required by the EU. This would ensure adequate detection in the distribution system even if diluted by a factor of 50. A level of 0.1 milligrams per liter would therefore be used as a threshold level to identify heating oil - below this level incidental contamination would be assumed to have occurred and the prohibition on use in highway, nonroad, locomotive, or marine applications would not apply. Despite its name, solvent yellow 124 does not impart a strong color to diesel fuel when used at the proposed concentration. Therefore, we do not expect that its use in diesel fuel containing the IRS-specified red dye would interfere with the use of the red dye by IRS to identify non-taxed fuels. We request comment on this assessment.

Solvent yellow 124 is chemically similar to other additives used in gasoline and diesel fuel, and has been registered by EPA as a fuel additive under 40 CFR part 79. Its products of combustion would not be anticipated to have an adverse impact on emission control devices, such

[240] The European Union marker legislation, 2001/574/EC, document C(2001) 1728, was published in the European Council Official Journal, L203 28.072001.

[241] Opinion on Selection of a Community-wide Mineral Oils Marking System, ("Euromarker"), European Union Scientific Committee for Toxicity, Ecotoxicity and the Environment plenary meeting, September 28, 1999.

as a catalytic converter. In addition, extensive evaluation and testing of solvent yellow 124 was conducted by the EC. This included combustion testing which showed no detectable difference between the emissions from marked and unmarked fuel. We understand that Norway specifically evaluated the use of distillate fuel containing solvent yellow 124 for heating purposes and determined that the presence of the Eurmarker did not cause an increase in harmful emissions from heating equipment. Based on the European experience with solvent yellow 124, we do not expect that there would be concerns regarding the compatibility of solvent yellow 124 in the U.S. fuel distribution system or for use in motor vehicle engines and other equipment such as in residential furnaces. We request comment on whether there are unique public health concern regarding the use of distillate fuel containing solvent yellow 124. The European Union intends to review the use of Solvent yellow 124 after December 2005, or earlier if any health and safety or environmental concerns about its use are raised. We intend to keep abreast of such activities and may initiate our own review of the use of solvent yellow 124 depending on the European Union's findings.

We also request comment on the extent to which jet fuel might become contaminated with solvent yellow 124 due to the presence of solvent yellow 124-containing fuels and jet fuel in the U.S. common carrier pipeline distribution system, and whether such contamination would raise concerns for the operation of jet engines. Due to safety concerns, jet fuel is held to very strict standards regarding the allowable presence of contaminants and additives. For example, the Department of Defense maintains a zero-tolerance for any contamination of jet fuel with the red dye required by the IRS (and EPA) which is chemically similar to solvent yellow 124. We are not aware that any testing has been done to date to assess whether solvent yellow 124 does raise similar concerns, and we request comment with any supporting data on this issue.

We do not believe that there any significant pathways for such contamination to take place other than by potential human error. In addition, the fact that the fuel distribution industry in the U.S. has been successful in managing contamination of jet fuel with red dye indicates that the potential contamination of jet fuel with solvent yellow 124 can also be successfully managed in the US fuel distribution system. Therefore, we believe that our proposed use of solvent yellow 124 should not pose a significant risk to the maintenance of jet fuel purity. We request comment on this assessment.

Solvent yellow 124 is marketed by several manufactures and is in current wide-scale use in the European community. We anticipate that these manufactures would have sufficient lead-time to increase their production of solvent yellow 124 to supply the need for fuel marker that would result from this proposal. We request comment on whether there are product licencing or other concerns regarding the manufacture of solvent yellow 124 for use under this proposed rule.

We request comment on other potential markers that might be used to identify and segregate heating oil from NRLM fuel. In particular, we ask that as commenters raise potential concerns with the use of solvent yellow 124 that they also identify other possible markers that could overcome their concerns without raising others. One potential alternative we have identified is the Clir-Code® marker system manufactured by ISOTAG Technologies Inc. The Clir-Code® marker system has been used extensively in U.S. fuel and includes a field test that employs a hand-held near infra-red detector which does not require the use of any reagents. EPA deferred proposing the use of the Clir-Code® marker because we believe that the advantage of a simpler field test would not compensate for the increased treatment cost relative to the use of solvent yellow 124. We furthermore seek comment on whether more than one marker could be selected, but which could all be detected using the same detection method. In this manner refiners would not be dependent on a sole supplier for the marker. Additional discussion of the rationale for our selection of solvent yellow 124 and the feasibility of its use is contained in Chapter 5 of the Draft RIA.

Since marked heating oil would be a relatively small volume product in many parts of the country, we anticipate that it will not be carried everywhere as a separate fungible product. In places where it is not carried as a separate fungible grade we anticipate that most shipments of marked heating oil will be from refinery racks or other segregated shipments directly into end-user tankage. In these areas any distillate supplied from the fungible supply system for heating oil purposes will therefore likely be spillover from 500 ppm NRLM supply. Clearly, in those parts of the country with high demand for heating oil, particularly the Northeast and Pacific Northwest, we anticipate that marked heating oil will in fact be carried by the distribution system as a separate fungible product. To the extent this is the case, it is entirely possible that heating oil will no longer be produced to diesel fuel cetane or aromatic specifications, reducing production costs. The most difficult to desulfurize streams in a refinery are in fact those that are low in cetane and high in aromatics. Shifting these streams to a unique heating oil product can therefore reduce desulfurization costs, while still producing a high quality heating oil (though we have not reflected this in our cost analysis in Section V.)

ii. Non-highway Distillate Baseline Cap

As discussed above, we are proposing use of a marker in heating oil to effectively distinguish uncontrolled heating oil from NRLM fuel, so that the NRLM standards can be enforced throughout the distribution system and at the end-user. However, in order to allow for the fungible distribution of highway diesel fuel and NRLM, and continue to have enforceable highway diesel fuel standards in the absence of a NRLM dye requirement, we are proposing that a non-highway distillate baseline percentage be established for each refinery and importer in the country. This non-highway baseline would be defined as the volume percentage of all diesel fuel and heating oil (number 1 and number 2) that a refinery or importer produced or imported during the specified baseline period that was dyed for non-highway purposes.

We propose that if a refiner chooses to fungibly distribute its NRLM and highway fuels, then under the first step of the nonroad program (June 1, 2007 - June 1, 2010), the volume of diesel fuel represented by its non-highway baseline percentage would have to either meet the 500 ppm NRLM standard or be marked as heating oil. All the remaining production would have to meet the requirements of the highway fuel program (i.e., 80 percent of this fuel would have to meet a 15 ppm sulfur cap). As we recognized in the highway rule, some variation in the production of highway and non-highway diesel fuel is normal from year to year. As a result, in any given year it may be possible that a refiner is unable to produce the amount of 15 ppm diesel fuel required to meet its highway requirement (80% of 100% minus the non-highway baseline) simply because of this normal variation. The provisions of the highway diesel rule already allow for a 5% shortfall in the production of 15 ppm fuel in a year as long as it is made up in the following year. We seek comment on whether any additional flexibility beyond that provided in the highway rule is appropriate to account for normal fluctuations in refinery output.

An example will help to explain the use of the baseline. Assume the baseline non-highway percentage has been established as discussed below and is 40%. That means 40% of the total diesel fuel production in the baseline years was non-highway fuel, dyed at the refinery gate. If the refinery then produced a total of 100,000,000 gallons of diesel fuel in 2008, 40,000,000 gallons would be its applicable non-highway baseline. If it then produced and marked 10,000,000 gallons as heating oil, 30,000,000 gallons of the remaining diesel fuel (dyed or undyed) would be subject to the NRLM standard of 500 ppm, and all the remaining diesel fuel, 60,000,000 gallons, would be considered highway diesel fuel and would have to meet the applicable 80/20 requirements.

We propose that a refiner, for each of its refineries, would need to choose either to continue to dye all of its NRLM fuel at the refinery gate, or to apply the non-highway baseline approach to all of its production. If a refinery's production could be split between these two options, the refiner could avoid the cap on NRLM imposed by the baseline percentage by dyeing additional volumes over its baseline, for example at their refinery rack or co-located terminal. The result could be a diversion of extra 500 ppm fuel to the highway market while the dyed 500 ppm fuel was used to serve the nonroad market, resulting in little or no production of 15 ppm highway diesel fuel. Therefore, the choice of whether to dye all of their 500 ppm NRLM fuel at the refinery gate, or comply with the non-highway distillate baseline would have to be made in advance. We propose that compliance with the baseline be determined on an annual basis. We therefore also propose that the decision of whether to dye NRLM 500 ppm fuel at the refinery gate or comply with the baseline could also be made on an annual basis.

This approach allows a refinery's production of 500 ppm NRLM fuel and heating oil to remain flexible in response to market demand, while ensuring that the proportion of fuel they produce in the future to highway and non-highway requirements remains consistent with their historical baseline production. Since the non-highway baseline is set as a percentage of production, the actual volume needed for compliance with this baseline would rise and fall with the refinery's total production of diesel fuel. In this way, it would provide refineries with flexibility similar to that under the 80/20 volume percentage provisions of the highway rule. If total production of diesel fuel decreased, the absolute volume of diesel fuel which had to be produced to highway or NRLM specifications would decrease. If total production increased, the amount of diesel fuel subject to the 80/20 highway and the NRLM standards would also increase. A refiner wishing not to be limited to this non-highway distillate baseline percentage of production could elect to segregate and dye its NRLM diesel fuel at the refinery gate.

Like the current dye requirement, this approach would focus compliance with the highway and NRLM requirements on the refinery or importer. Once undyed 500 ppm or 15 ppm diesel fuel was produced or imported and accounted for under the baseline percentage approach, it could be mixed and shipped fungibly, and sold to either the highway or the NRLM diesel fuel market by anyone further down the distribution system. This would provide a significant degree of market flexibility to refiners and distributors and enable the efficient distribution of diesel fuel. Compliance with the non-highway baseline would be enforced at the refinery gate in the same manner as the current 2006 highway provisions. With the marker for heating oil, compliance with the 15 ppm and 500 ppm standards could also be enforced through to the end-user. But most importantly, this approach would maintain the health benefits and fuel availability needs of the highway diesel fuel program, because the overall volume of highway diesel fuel produced to the 15 ppm cap would be maintained.

iii. Setting the Non-highway Distillate Baseline

The purpose of the non-highway baseline is to identify a historical level of non-highway production occurring prior to implementation of the provisions of this proposal, for use as a baseline after such implementation. We propose to determine the non-highway baseline percentage for each refinery by averaging the volume of dyed diesel fuel and heating oil (number 1 and number 2, excluding jet fuel and exported fuel) that it produced or imported annually over the three year period from January 1, 2003 through December 31, 2005, and dividing that volume by the average of all diesel fuel and heating oil (number 1 and number 2, excluding jet fuel and exported fuel) it produced or imported annually over the same period (and then multiplied by 100).[242] By using a multi-year average, variations that might otherwise occur from year to year in a refinery's production will get averaged out. Importers would establish a separate baseline for each area of importation.[243]

Selecting a baseline period prior to finalization of the final rule would help to prevent the possibility of entities inappropriately adjusting their operations solely for the purpose of modifying their baseline. At the same time, setting a baseline period as close to the implementation date as possible helps to capture the most recent changes in the industry's production patterns. The proposed period of January 1, 2003 through December 31, 2005 is split roughly equally between production prior to the final rule and production after the final rule to appropriately balance these competing objectives. One advantage of ending the baseline period on December 31, 2005 is that it allows the opportunity for refiners to generate credit for the early production of 500 ppm NRLM fuel after that date, and at the same time avoid having to dye it at the refinery gate. The three year period serves to limit any potential actions to inappropriately adjust the baseline that a refinery might otherwise attempt. A refiner or importer would have to dye and sell a greater fraction of its fuel to the non-highway market over an extended period of time to significantly modify its baseline. The potential financial loss associated with this, particularly if other refineries or importers tried to do the same thing, would likely be prohibitive.

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[242] Specialty fuels such as JP-5, JP-8 and F76 are in some instances also used in nonroad diesel equipment today. However, our expectation is that the majority of this fuel is today and will be in the future continue to be used in tactical military equipment that would be exempted from the provisions of this proposal. Consequently, we propose that these fuels would not be counted in either setting the baseline or in determining compliance with the baseline.

[243] The areas would be defined as the credit trading areas (CTAs) as defined in the highway rule.

At the same time, we anticipate that a number of refiners may be changing their highway diesel production volumes as they comply with the highway diesel fuel standards in 2006. To the extent that a refiner planned to lower its highway production in 2006, a non-highway baseline set based on 2003-5 data would penalize them by forcing them to continue to meet the highway requirements for a greater volume, based on their pre-2006 production pattern. To avoid this situation, we propose that refiners would be allowed to set their non-highway baseline percentage using June 1, 2006 through May 31, 2007 as the baseline time period. By doing so the refinery's baseline would automatically take into account changes made for compliance with the 2006 highway standard. It would, however, preclude that refinery from participating in the early NRLM credit program prior to June 1, 2007 using the baseline approach, and would require them to continue dyeing their NRLM at the refinery gate until June 1, 2007, since that is the period during which the baseline was being established. Since the purpose of this option is to provide an opportunity to account for the physical changes refineries make in complying with the highway rule, we propose that this option would only apply to refiners and not importers.

Each refinery and importer would have to submit its application for a non-highway baseline to EPA by February 28, 2006 along with the supporting information. If the refinery elected to use the optional baseline period, we propose that the refinery would have to submit its application for a non-highway baseline to EPA by August 1, 2007. EPA would then approve these baselines by June 1, 2006 and any optional baselines by December 1, 2007. We propose that any refinery or importer which was not in operation for the full period of January 1, 2003 through December 31, 2005 would establish their baseline using data from the period they were in operation, as long as that period was greater than or equal to 12 months. The 12 months need not be continuous. Any refinery or importer unable to establish a baseline during this period would have to comply using the dye alternative. In the case of a new or restarted refinery or new importer, we propose to assign a non-highway baseline percentage reflecting the projected average production of non-highway fuel in 2004 for their region of the country. We propose to use the credit trading areas (CTAs) as defined in the highway Based on data from the Department of Energy's Energy Information Agency (EIA) on the current production of low and high sulfur diesel fuel and heating oil, and EIA and EPA projections of future fuel use, these PADD average non-highway baseline would be as shown in Table IV-1.

TABLE IV-1 -- NON-HIGHWAY BASELINE FOR NEW REFINERIES

PADD 1	PADD 2	PADD 3	PADD 4	Oregon and Washington	Alaska	Hawaii	California[244]
41%	20%	26%	13%	21%	68%	40%	0%

In discussions with various refiners, there was a strong interest in allowing refiners with multiple refineries and importers with multiple points of import to aggregate the baselines across

[244] A value of zero is proposed for California, since we anticipate that all non-highway diesel fuel in California will be covered by the same State standards applicable to highway diesel fuel during this time period.

all of their facilities nationwide. However, since the baselines determine how much of a refineries production must comply with the highway standards, allowing nationwide aggregation of the baselines would have the same impact as allowing nationwide averaging, banking, and trading of credits under the highway rule. That approach was rejected in the highway rule due to the negative impact it would have on the nationwide availability of 15 ppm highway diesel fuel. For the same reason we are not proposing to allow nationwide aggregation of the non-highway baselines. However, in the highway rule, we do allow credit trading within certain credit trading areas (CTAs). We seek comment on allowing the aggregation of non-highway baselines within the same CTA and how such aggregation could be accomplished. We also seek comment on whether a trading program could be established that allowed for refiners with only one refinery within a CTA to benefit from similar flexibility, and whether some reasonable restrictions on refiners who aggregate baselines are needed to protect the integrity of the highway program.

EPA requests comments on the provisions described above for establishing the non-highway baseline percentage for each refinery and importer. We also request comment on any alternative provisions that could be used to accomplish the objectives discussed above.

iv. Diesel Sulfur Credit Banking, and Trading Provisions for 2007

This proposal includes provisions for refiners and importers to generate early credits for production of 500 ppm NRLM fuel prior to June 1, 2007. This will provide implementation flexibility at the start of the 500 ppm NRLM standard in 2007. These credits would be tradeable and could be used to delay compliance with either the 500 ppm NRLM standard in 2007 or the 15 ppm nonroad standard in 2010. The proposed banking and trading provisions would allow an individual refinery to purchase credits and delay compliance. This would allow for a somewhat smoother transition at the start of the program, with some refineries complying early, others on time, and others a little later. Nevertheless, on average the overall benefits of the program would be obtained or perhaps increased, and some environmental benefits could be achieved earlier than expected. Perhaps the most advantageous use of these credit provisions, however, might be for individual refineries to utilize available credits to permit the continued sale of otherwise off-spec product during the start up of the program when they are still adjusting their operations for consistent production to the new sulfur standards.

<u>Credit Generation:</u>

We propose two ways to generate credits that can be used to allow for high sulfur NRLM fuel to be produced after June 1, 2007. First, we propose that a refinery or importer can generate credit for early production of NRLM diesel fuel to the 500 standard from June 1, 2006 through May 31, 2007. Credits would be calculated either using the non-highway baseline approach or by counting 500 ppm NRLM dyed at the refinery gate. Refiners that chose to establish their non-highway baseline using the June 1, 2006 - May 31, 2007 baseline period would be precluded from generating any early credits using the non-highway baseline approach. Second, under the small refiner hardship provisions described below in subsection C, small refiners could generate credits for any production of NRLM fuel to the 500 ppm standard from June 1, 2007 through May 31, 2010. In either case, credits could be banked for future use, or traded to any other refinery or importer nationwide. For early credits and small refinery credits generated using the non-highway baseline approach, these credits would be calculated according to the following formula:

High-Sulfur NRLM credits[245] = (15 ppm production volume + 500 ppm production volume) - (100% - non-highway baseline percentage) * (total #1 and #2 distillate production excluding jet fuel and exported fuel).

Early credits or small refinery credits generated using the dye option would be calculated using the following formula:

High-Sulfur NRLM credits = 500 ppm production volume dyed at the refinery gate.

If the excess production was 15 ppm fuel instead of 500 ppm fuel, the refiner would of course still have the option of using it to generate 500 ppm highway credits under the existing highway diesel provisions. Credit could not be earned under both programs.

Credit Use:

There would be two ways in which refiners could use high-sulfur NRLM credits. First, we propose that these credits could be used during the period from June 1, 2007 - May 31, 2010 to continue to produce high sulfur NRLM diesel fuel. Any high sulfur NRLM fuel produced, however, would have to be dyed red at the refinery gate, kept segregated from other fuels in the distribution system, and tracked through the use of unique codes on product transfer documents.

Only at the point in the distribution system where NRLM fuel has been dyed to IRS specifications for excise tax purposes (e.g., after a terminal or bulk plant) do we propose that high sulfur and 500 ppm sulfur NRLM fuels could be commingled. Such commingling will not diminish the PM and SO2 emission reductions or other benefits associated with the 500 ppm sulfur standard. However, in order to ensure that owners of nonroad equipment can be confident in knowing whether the fuel being purchased meets the 500 ppm cap, the PTD and labels for any commingled fuel will have to indicate that the sulfur level exceeds 500 ppm. This is particularly a concern for some 2008 and later model year equipment that may need to run on 500 ppm or lower sulfur fuel in order to achieve the emission benefits in-use of the standards proposed today, as discussed in Section III.

In most cases we anticipate that the distribution costs associated with segregating such a small volume product will prevent high-sulfur NRLM from being carried in the fungible distribution system. As a result, we anticipate that only those refineries that have their own segregated distribution system could continue to produce solely high sulfur NRLM fuel after June 1, 2007. Since there are few refineries set up to accomplish this, our expectation is that the most likely manner in which refiners will be able to use high-sulfur NRLM credits will be through sales

[245] For the purposes of this proposal, the credits are labeled on the basis of their use in order to follow the convention used in the highway rule. A high-sulfur credit is generated through the production of one gallon of 500 ppm NRLM fuel and allows the production of one gallon of high sulfur NRLM fuel.

made directly from their on-site fuel rack or co-located terminal. Nevertheless, in order to have confidence that refiners are making the transition to 500 ppm for NRLM uses, we seek comment on whether caps on the use of credits would be necessary. In particular, we seek comment on placing a cap on the use of credits at 25 percent of its non-highway baseline, less marked heating oil, beginning June 1, 2008.

The second way in which refiners and importer could use high-sulfur NRLM credits is by banking them for use during the June 1, 2010 - May 31, 2012 period. During this period they could continue producing 500 ppm fuel subject to the usage restrictions that apply during that period, as discussed in subsection B.2.b.ii below. This use of high-sulfur credits would provide a cost-effective environmental benefit, since credits generated from the reduction of sulfur levels from high sulfur to 500 ppm would be used to offset the much smaller increment of sulfur control from 500 ppm down to 15 ppm.

b. 2010

After June 1, 2010, the fuel standards situation is simplified considerably and the fuel program structure can therefore also be simplified. The need for the non-highway baseline percentage disappears, since all highway and nonroad diesel fuel must meet the same 15 ppm cap. Furthermore, the only high sulfur distillate remaining in the market should be heating oil, since we are proposing that high sulfur diesel fuel no longer be permitted to be used in any NRLM equipment. Heating oil would have to be kept segregated. Preventing its use in NRLM equipment could be enforced on the basis of sulfur level, avoiding the need for a unique marker to be added to heating oil.

After June 1, 2010, under this proposal locomotive and marine diesel fuel would be allowed to remain at the 500 ppm level. In addition, assuming we allowed the continued production and use of 500 ppm nonroad diesel fuel through the small refiner hardship provisions discussed in subsection C and fuel credit provisions, 500 ppm nonoad fuel would continue to exist in the distribution system as late as May 31, 2014. A refiner could produce 500 ppm diesel fuel without the use of credits for the intended use in locomotive and marine applications, but if this 500 ppm fuel later made its way into nonroad equipment, less 15 ppm nonroad fuel would be produced and the full benefits of the 15 ppm nonroad standard would not be achieved. If this happened to a large enough extent it could call into question the adequate supply of 15 ppm for nonroad purposes beginning in 2010. Thus, some method is needed to differentiate locomotive and marine 500 ppm diesel fuel from nonroad 500 ppm diesel fuel after June 1, 2010. EPA is proposing to use a marker for this purpose.

i. A Marker to Differentiate Locomotive and Marine Diesel from Nonroad Diesel

This proposal would allow the limited production of 500 ppm nonroad diesel fuel by small refiners and by other refiners through the use of credits between 2010 and 2014 (see Section IV.B.3.b). This 500 ppm fuel could only be used in pre-2011 model year nonroad diesel engines, and would have to be segregated from 15 ppm nonroad diesel fuel and 500 ppm locomotive and marine diesel fuel. To ensure compliance with the proposed segregation requirements for such fuel, it would be necessary for parties in the distribution system, and for EPA, to be able to distinguish such 500 ppm nonroad diesel fuel from 500 ppm locomotive and marine diesel fuel. Differentiating locomotive and marine diesel fuel from nonroad diesel fuel presents a very analogous situation, though perhaps on a smaller scale, to that described above for heating oil prior to June 1, 2010.[246] As a result, we propose to use a marker to segregate locomotive and marine diesel fuel from 500 ppm nonroad diesel fuel beginning June 1, 2010. Since both fuels need to be dyed red for tax purposes prior to sale, for the reasons discussed above with respect to heating oil, we propose that solvent yellow 124 be used as the marker for locomotive and marine diesel fuel beginning June 1, 2010. We propose that the marker would be required to be added at the refinery gate just as visible evidence of the red dye is required today, and fuel containing more than the trace concentration of 0.1 mg/l of the marker would be prohibited from use in any nonroad application.

Since marked locomotive and marine diesel fuel would be a relatively small volume product, we anticipate that in most parts of the distribution system it would not be carried as a separate product in the fungible distribution system. Therefore we anticipate that most shipments of marked locomotive and marine fuel would be from refinery racks or other segregated shipments directly into end-user tankage. Any diesel fuel supplied off the fungible supply system for locomotive and marine uses would therefore likely be spillover from 15 ppm nonroad or highway diesel supply.

Since we anticipate that 500 ppm locomotive and marine diesel fuel will be a small volume product, not carried in the fungible distribution system, and only available in limited locations, we also seek comment on whether the approach of using a marker for locomotive and marine diesel fuel could be replaced with an alternative approach. Specifically, we seek comment on whether to just limit supply of 500 ppm locomotive and marine diesel fuel to segregated shipments, with refineries being liable to ensure and keep records demonstrating that 500 ppm fuel produced for locomotive and marine purposes was distributed solely for these purposes.

ii. Diesel Sulfur Credit Banking and Trading Provisions for 2010

For the reasons described above for 2007, we are proposing a similar diesel sulfur credit banking and trading program for 2010. We propose that refiners and importers could generate early credit for production of 15 ppm nonroad diesel fuel prior to June 1, 2010. These credits could be used to delay compliance with the 15 ppm nonroad diesel standard in 2010. As in 2007, while it is possible that a refinery could entirely delay compliance with the 15 ppm standard in 2010 through the use of credits, the most advantageous use of these credit provisions is likely to be the continued sale by individual refineries of otherwise off-spec product during the start up of the 2010 program, when they are still adjusting their operations for consistent production to the 15 ppm sulfur standard.

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[246] Without the proposed marker requirement for locomotive and marine diesel fuel discussed in this section, we expect that there would be no physical difference between 500 ppm nonroad diesel fuel and 500 ppm locomotive and marine diesel fuel.

Credit Generation:

Under this proposal, highway and NRLM fuels of like sulfur level would be allowed to be distributed fungibly, and as such would be indistinguishable. For example, prior to June 1, 2010 undyed 15 ppm diesel fuel would be distributed together whether or not it was later dyed for nonroad purposes. Consequently, we are proposing that credits for production of early 15 ppm nonroad diesel fuel prior to June 1, 2010 be determined using the non-highway baseline. Any volume up to a refinery's total highway requirement (100 percent minus the non-highway baseline) would continue to be counted under the provisions of 2007 highway diesel fuel program.[247] Any production of 15 ppm fuel greater than this amount (100% minus the non-highway baseline) beginning June 1, 2009 could be used to generate early nonroad credits.

An example will help to explain the use of these credits. Assume the baseline non-highway percentage has been established at 40% and the refinery produces a total of 100,000,000 gallons of diesel fuel from June 1, 2009 - December 31, 2009. It's applicable non-highway baseline would be 40,000,000 gallons. If it then produced and marked 10,000,000 gallons of heating oil, 30,000,000 gallons of the remaining diesel fuel (dyed or undyed) would be subject to the NRLM standard of 500 ppm, and the remaining 60,000,000 gallons of diesel fuel would be considered highway diesel fuel and would have to meet the applicable 80/20 requirements(48,000,000 at 15 ppm and 12,000,000 at 500 ppm). If the refiner instead produced only 20,000,000 gallons of fuel to the 500 ppm NRLM standard and produced 70,000,000 gallons to the 15 ppm standard, then it would receive credit for the 10,000,000 gallons excess 15 ppm NRLM fuel that it produced. In this example the refiner could also earn 3,000,000 highway credits for the excess production of 15 ppm highway fuel (1:4 ratio).

In addition to this source of credits, we propose two other sources of credits to allow production of 500 ppm nonroad diesel fuel after June 1, 2010. First, as discussed in subsection B.3.a.iv above, high-sulfur NRLM credits generated prior to June 1, 2010 could be converted into 500 ppm nonroad credits and carried over for use beginning June 1, 2010. Second, under the small refiner hardship provisions described below in subsection C, small refiners could generate credits for any production of NRLM fuel to the 15 ppm standard from June 1, 2010 through May 31, 2012. These credits could be traded to any other refinery or importer nationwide.

We seek comment on whether credits should be permitted to be generated prior to June 1, 2009. Our proposal would restrict the early credit period to just one year for two main reasons. First, any 15 ppm fuel produced prior to June 1, 2009 can be treated as highway diesel fuel and any credits generated on the fuel under the highway program can be traded under the highway

[247] Under the highway program four gallons of excess 15 ppm diesel fuel produced or imported would generate one 500 ppm diesel fuel credit. This credit grants the refiner or importer the right to produce one additional gallon of undyed 500 ppm diesel fuel between June 1, 2006 and May 31, 2010. These credits can be used (or traded within the PADD in which they were generated) to produce or import less than 80% of its highway volume as 15 ppm fuel. This would continue under this proposal for any production up to (100% minus the non-highway baseline). For any volume of 15 ppm fuel greater than 100% minus the non-highway baseline a refiner could either receive gallon-for-gallon nonroad credit under this proposal, or treat it as highway fuel and receive 1:4 credit under the provisions of the highway rule.

credit program. We do not want the early nonroad credit provisions to detract from the smooth functioning of the highway diesel credit program. Second, we do not want the early credit provisions to undermine the availability of 15 ppm diesel fuel for nonroad applications in 2010. Allowing more than a years worth of credits to be generated, plus up to a years worth of high sulfur credits to be generated and carried over for use in 2010 would raise concerns that insufficient 15 ppm nonroad diesel fuel might be produced in 2010 to ensure availability everywhere nationwide. Nevertheless, we seek comment on extending the period for early credit generation and on this assessment.

Credit Use:

We propose that 500 ppm nonroad credits could be used on a gallon for gallon basis during the period from June 1, 2010 - May 31, 2012, allowing continued production of 500 ppm nonroad diesel fuel. Small refiners could continue to produce 500 ppm nonroad diesel until June 1, 2014 without credits. Any 500 ppm nonroad fuel produced would have to be dyed red at the refinery gate, kept segregated from other fuels in the distribution system, and tracked through the use of unique codes on product transfer documents all the way through to the end-user. Refiners wishing to produce 500 ppm fuel and sell it as nonroad would have to get EPA approval in advance demonstrating how they will ensure such segregation.

Given the cost and burden associated with segregating 500 ppm nonroad diesel fuel as a separate product in the distribution system, we anticipate that the most likely manner in which refiners will be able to use 500 ppm nonroad credits will be through sales made directly from their on-site fuel rack.

We request comment on all aspects of the proposed credit trading system.

c. 2014

Beginning June 1, 2014, after all small refiner and credit provisions have ended, both the 15 ppm nonroad diesel fuel standard and the 500 ppm locomotive and marine diesel fuel standard could be enforced based on sulfur level throughout the distribution system and at the end-user. There would no longer be a need for a baseline, a marker, or a dye. Consequently, we are proposing that after May 31, 2014 the different grades of diesel fuel, 15 ppm, 500 ppm, and high-sulfur would merely have to be kept segregated in the distribution system.

3. Other Options Considered

In developing the proposed program structure described above, we also evaluated a number of other possible approaches. Some of the alternatives discussed below would allow for even greater fuel fungibility, for example, extending to smaller volume products such as those produced through the use of credits. However, these alternative approaches would either place more restrictions on refinery operations, or raise significant enforcement and program integrity concerns. As a result, we are not proposing the following alternatives but seek comment on them, including ways to minimize or alleviate the concerns associated with them.

a. Highway Baseline and a NRLM baseline for 2007

The proposed program described above relies on a non-highway baseline percentage to distinguish highway fuel from NRLM fuel, and a marker to distinguish heating oil from NRLM fuel. In lieu of using a marker for heating oil, another approach would be to use a second baseline aimed at identifying the NRLM portion of non-highway diesel fuel. In this case a highway baseline would be established consistent with the non-highway baseline proposed above (100 percent minus the proposed non-highway baseline). The highway 80/20 standards would apply to this baseline. A second NRLM baseline would be established to which the 500 ppm NRLM standard would apply. The remaining diesel fuel percentage would be uncontrolled (i.e., it could be high sulfur). This approach would allow for greater fungibility of fuels with the same sulfur level. Not only could 500 ppm highway and 500 ppm NRLM fuel be distributed together, but high sulfur NRLM fuel produced through the credit and hardship provisions could be fungibly distributed with heating oil. Heating oil would not need to contain a marker. As a result, this approach would allow for greater flexibility in using the fuel credit and hardship provisions. The disadvantage, however, is that refiners would face additional burden when shifting into the heating oil market. An explanation of this approach follows.

i. Highway Baseline

The highway baseline would be very analogous to the non-highway baseline proposed above. It would be calculated in the same way, except that it would be 100 percent minus the proposed non-highway baseline. The requirement that NRLM fuel be dyed at the refinery gate would become voluntary. From June 1, 2007 through May 31, 2010 any volume of 500 ppm fuel not dyed at the refinery gate would have to meet the 80/20 highway provisions up to the refinery specific highway baseline percentage. The highway baseline percentage would be determined for each refinery and importer in the same manner as described above for the non-highway baseline.

ii. Nonroad, Locomotive, and Marine Baseline

Under this approach, a refiner or importer would be assigned a NRLM baseline percentage. This baseline percentage of a refinery's or importer's current high-sulfur diesel fuel and heating oil (number 1 and number 2) production would be deemed to be NRLM diesel fuel and thus, subject to the proposed 500 ppm cap beginning June 1, 2007. The remaining percentage would remain uncontrolled and would not need to contain a marker. A refiner's NRLM baseline percentage would be applied to the percentage of distillate not included in the highway baseline (i.e., the proposed non-highway baseline). For example, if a refiner's highway baseline was 50% and its NRLM baseline was also 50%, then 25% of its production would have to meet the 500 ppm NRLM standard.

If a refiner chose not to use the NRLM baseline percentage, a refinery or importer would have to add the proposed marker and segregate their heating oil from any NRLM diesel fuel throughout the distribution system, including high sulfur NRLM diesel fuel (produced through the use of credits or by small refiners or refiners utilizing hardship provisions). The refinery would have to demonstrate that the fuel was segregated all the way through to the end-user and that the end-user used the fuel for legitimate heating oil purposes only. NRLM end-users would be prohibited from using any fuel with a marker.

There are, however, certain difficulties in establishing an NRLM baseline percentage. Unlike the situation today where highway diesel fuel and non-highway distillates are accounted for based upon their different sulfur levels and the presence of red dye, there is no easy way to measure a given refinery's current production of NRLM diesel fuel as compared to their production of heating oil, in order to accurately establish an individual refinery baseline percentage. Generally the two fuels are produced and shipped as a single fuel. We considered whether refiners and importers could reliably track their high sulfur fuel through the distribution system and estimate the volumes used as diesel fuel and heating oil to establish individual refinery baselines. However, most high sulfur diesel fuel and heating oil is shipped by fungible carriers and we do not believe that sufficient data exist to accurately determine which refiner's fuel was actually consumed in either end-use. Discussion with several refiners have supported this belief. Therefore, we developed an approach that would assign each refinery a percentage of their current high-sulfur distillate production, based on the PADD they reside in, as their NRLM baseline. PADDs 1 and 3 would be combined due to the large amount of high sulfur non-highway diesel fuel shipped from PADD 3 to PADD 1 today.

Under this approach we would project consumption of NRLM diesel fuel and heating oil to determine the relative consumption of these two fuels by PADD. This would be the NRLM baseline assigned to refiners and importers in that PADD. This volume percentage of non-highway diesel fuel would then be considered NRLM and have to meet the proposed 500 ppm cap beginning June 1, 2007. The remainder of the non-highway diesel fuel would remain uncontrolled by EPA and would only have to meet any applicable state sulfur standards for heating oil. If a refinery desired to only produce heating oil, then they could either purchase credits from other refineries or segregate and mark their heating oil.

Using EIA estimated fuel consumption data for the year 2000, grown to 2008 using EPA NONROAD emission model growth rates for nonroad and EIA growth rates for other fuels, produces the NRLM baseline percentages shown in Table IV-2.

TABLE IV-2 – NRLM DIESEL FUEL BASELINE PERCENTAGES

PADD	Breakdown of High Sulfur Distillate Fuel Production		
	Nonroad	Loco and Marine	Combined
1 and 3	26%	16%	42%
2	57%	27%	84%
4	67%	29%	96%
5 (excluding Alaska)	59%	18%	77%
Alaska	22%	28%	50%

One particular concern with this NRLM baseline approach is whether refiners can easily respond to above average demand for heating oil (e.g., in unusually cold winter). As today, any short-term, unexpected increases in demand will be made up from existing inventories of fuel. Today, if there are insufficient inventories of high sulfur fuel, 500 ppm inventories are tapped as well. The same situation will continue to occur in the future. As a result, the issue is not one of being able to supply the market with sufficient fuel to meet demand, but rather what quality of fuel must be produced to build inventories back up after high demand has brought them down. This could be addressed in a number of ways. First, in setting the NRLM baseline itself we could make sure it is not too high and allows for sufficient volumes of high sulfur heating oil to be produced even in the event of an unusually cold winter. Second, we could allow credits to flow across the country through a nationwide credit trading program. This would allow the production of high sulfur fuel to likewise flow across the country to the places experiencing higher than normal demand. Third, provisions could be made for deficit carry over of credits. If demand for high sulfur fuel is unusually high in one year, a refiner could increase production to respond to that demand as long as it is made up the following year.

Another concern raised by this baseline approach is the inability to accurately tailor it to each refinery's actual historical production of NRLM. This NRLM baseline approach does reflect the historical practice for the industry as a whole - refineries produced fungible high sulfur fuel for distribution as a common pool of fuel that was later sold as either NRLM or heating oil. However, it does not allow for refinery specific customization. The proposed non-highway baseline approach determines the specific non-highway percentage for each refinery, and the actual volume of marked and dyed heating oil is allowed to vary. The lack of individual specificity for the NRLM baseline approach, however, avoids the need to add a marker to heating oil.

iii. Combined Impact of Highway and NRLM Baselines

These baselines, as with the proposed non-highway baseline, are set on the basis of a percentage of production. Therefore, as a refinery's overall production of diesel fuel rises and falls, the required volume of each grade of fuel will also rise and fall. Thus, the baselines are flexible enough to respond to changes in a refinery's market or situation. Furthermore, a nationwide credit trading program for 500 ppm NRLM fuel could be put in place, allowing refineries further flexibility to change production in response to consumer demand. To add additional flexibility we could allow for some deficit carry-over of NRLM credits. Finally, a refinery could always avoid use of the baselines entirely by dyeing or marking their fuel and ensuring that it is only used in appropriate end-uses.

The combined effect of the highway baseline and NRLM baseline is shown in Table IV-3.

TABLE IV-3 – COMBINED IMPACT OF THE HIGHWAY AND NRLM BASELINES FOR JUNE 1, 2007 - MAY 31, 2010

Sulfur level	Percentage requirement
15 ppm	> or = 80% x (highway baseline) or;
	> or = 80% x All undyed diesel fuel (whichever is less)
15+500 ppm	>or= (highway baseline) + (NRLM baseline)(100%-highway baseline) or;
	= All fuel without a marker and segregated through to the end-user

An example will help to explain the use of these baselines. Assume a refinery in PADD 3 produces 100,000,000 gallons of diesel fuel and heating oil per year from 2003-5, 60 percent of which is undyed. Its highway baseline would thus be 60 percent of its total diesel fuel and heating oil production. Its NRLM baseline, assigned by EPA from Table IV-2, would be 42 percent applied to the remaining 40 percent of total distillate, or 16.8 percent of total distillate. If the refinery then continues to produce a total of 100,000,000 gallons of diesel fuel in 2008, 60,000,000 gallons would be required to meet the highway 80/20 standards, i.e., 48,000,000 at 15 ppm and 12,000,000 at 500 ppm. An additional 16.8 percent, or 16,800,000 gallons would be required to meet the 500 ppm NRLM standard, for a total required 500 ppm production of 28,800,000 gallons. Its remaining 23,200,000 gallons of production could remain uncontrolled and could be sold as heating oil or high sulfur NRLM. If the refiner reduced this 23,200,000 gallons to 500 ppm it would then earn credits that could be sold to another refiner.

b. Locomotive and Marine Baseline for 2010

The proposed non-highway baseline percentage approach described above relies on a marker to distinguish locomotive and marine diesel fuel from nonroad diesel fuel after June 1, 2010. Just as in the alternative above, a baseline for locomotive and marine fuel could be used in lieu of a marker. The 2010 locomotive and marine baseline would be established by EPA and used in the same manner as described above for the NRLM baseline in 2007. Possible locomotive and marine baselines are shown in Table IV-2. The advantage of this baseline approach over the proposed approach is that it allows for the fungible distribution of 500 ppm locomotive and marine fuel with 500 ppm nonroad fuel produced through the credit and hardship provisions. As a result, this approach would allow for greater flexibility in using the diesel fuel credit and hardship provisions. The disadvantage, however, is that refiners wishing to produce locomotive and marine fuel in quantities larger than their baseline would have to purchase credits from other refiners.

It may be possible for each refiner and importer to track the use of its diesel fuel to determine what percentage was used by railroads and marine vessels. This information could then be used in lieu of the PADD average values shown in Table IV-2. However, this approach would have to be taken by every refinery and importer to avoid double counting. Any new refineries or importers would still be assigned a locomotive and marine baseline from Table IV-2. Tracking diesel fuel use in this instance could be feasible, since the number of railroads and marine terminals is relatively small. We request comment on this alternative approach and details of how such an approach could be implemented.

c. Designate and Track Volumes in 2007

One main benefit of the proposed non-highway baseline approach is to allow 500 ppm highway and 500 ppm NRLM diesel fuel to be fungibly distributed while still ensuring achievement of the benefits of the highway program. In developing the proposal, several refiners recommended another possible approach, referred to here as the “designate and track” approach. It was suggested as a replacement for the proposed non-highway baseline approach. After further discussion, a modified designate and track approach was also described as an alternative for refiners to choose from, in addition to the baseline and dye alternatives. We discuss both of these designate and track approaches below.

We invite comment on these designate and track approaches. However, we are not proposing them for a number of reasons as discussed in more detail below. We are concerned that such an approach could reduce the volume of 15 ppm fuel required to be produced under the highway program, eroding environmental benefits and calling into question availability of 15 ppm highway fuel. This concern is compounded by serious concerns with respect to the workability and enforceability of such a program, particularly if it is a replacement for the baseline approach. We are also concerned that such an approach would place too much burden on the many entities, including many small entities, in the distribution system. Unlike the situation with the existing highway diesel program, the downstream parties, not the refiners, would be liable if insufficient 15 ppm highway diesel fuel was produced and distributed. Finally, these concerns would appear to be reduced if the designate and track approach were to be allowed as a choice for refiners. However, it may then be of such limited usefulness that it is of little value and only adds program complexity. We are interested in comments describing how these concerns could be addressed in order to implement such an approach.

i. Designate and Track as a Replacement for the Non-highway Baseline Approach

Under the designate and track approach, a refiner or importer would designate its 500 ppm diesel fuel as highway diesel fuel or NRLM diesel fuel and this refiner designation would be used to differentiate highway fuel and NRLM fuel instead of the non-highway baseline. For example, the highway 80/20 requirement would only apply to the amount of diesel fuel designated by the refinery or importer as highway diesel fuel. A marker would still be used to segregate heating oil, but the dye requirement for NRLM at the refinery gate would be removed. As with the baseline approach, undyed 500 ppm highway and 500 ppm NRLM could be fungibly distributed up until the point the NRLM diesel fuel is dyed. These refiner designations would have to follow the fuels through the distribution system. Under this designate and track approach, fuel distributors would be required to ensure that they did not sell more diesel fuel to the highway market than they took in as highway fuel. For example, if 60% of the fuel they took in was originally designated by the refineries as NRLM, they could not sell more than 40% to the highway market. The refiner or importer would have no obligation to ensure this occurred and no liability if it did not occur.

This approach shifts the focus from monitoring and enforcement of production at the refinery gate to monitoring and enforcement of the volumes of fuel handled by each party in the distribution system. Under the designation and track approach, refiners and importers would have complete flexibility to designate individual batches of diesel fuel or even portions of batches as either highway fuel or NRLM fuel. A pipeline could mix undyed highway 500 ppm and NRLM diesel fuels and ship them fungibly as a single physical batch as in the non-highway baseline approach. However, two sets of records would be kept, one applicable to the highway fuel portion and one applicable to the NRLM fuel portion. Whenever all or a portion of the fungible batch was split off or sold, that portion would have to carry one of the two designations, highway or NRLM. The sum of the volumes designated as either fuel would always be required to add up to the volumes designated in the original batch. A combination of fungibly mixed batches would be handled similarly, with the total volumes of each designation of volume split off or sold equaling the sum of the volumes of each designation of the original batches, respectively.

Each party in the distribution system beyond the refinery gate would be required to reconcile the volumes taken in and the volumes discharged, based on the designations of the diesel fuel, annually. For example, assume that over a year a pipeline received a total of 100,000,000 gallons of undyed 500 ppm diesel fuel from various refineries, with 70% of what it received being designated by the refiners as highway and 30% designated as NRLM. Over the year the pipeline would also designate what it discharged at various terminals or other points as either highway or NRLM. The pipeline would have to ensure that over a year's time it did not discharge more than 70% of the volume of this entire pool of 500 ppm diesel fuel as highway diesel fuel, to ensure that fuel designated as NRLM was not inappropriately converted to highway use. It could not discharge more 500 ppm fuel as highway than it took in as highway, and it would have to discharge at least as much 500 ppm diesel fuel designated as NRLM as it took in. This same reconciliation process would apply to every party in the distribution system.

A primary advantage of this designate and track approach for refiners is that it would allow them complete flexibility in deciding how much 15 ppm highway diesel fuel to produce, allowing them to react to changing market conditions. As long as 80 percent of whatever volume they designated as highway was 15 ppm, they would be in compliance. However, in order to maintain the integrity of the highway program, EPA would have to ensure that all diesel fuel designated as NRLM eventually was dyed and sold to the NRLM market. Otherwise, for example, refiners and importers could simply designate diesel fuel under the more lenient NRLM diesel fuel program while downstream in the distribution system the fuel was shifted to the highway diesel fuel market. Such shifting would compromise the required 80/20 split between 15 ppm and 500 ppm highway diesel fuel and undermine the benefits and integrity of the highway program. Various refiners proposed that EPA compare the volume of all diesel fuel designated as NRLM by the refineries and importers nationwide and compare that with the volume dyed nationwide to determine whether the approach was working. Unfortunately, this approach is not feasible, since EPA could not determine and take corrective action against refiners, importers, or distributors if the designated and dyed volumes did not reconcile. To locate the cause of a discrepancy between the designated and dyed volumes, EPA would have to audit the records of every party in the distribution system nationwide. The refiners and importers would not face any liability under this approach for any downstream discrepancy unless there was evidence of collusion with downstream entities.

Thus, under this designate and track approach, EPA would need to require that all parties handling undyed diesel fuel designated as NRLM maintain records for each batch of fuel shipped and received and submit reports periodically demonstrating that the volume of undyed NRLM designated fuel that they dyed plus that transferred undyed to another fuel distributor equaled or exceeded the volume of undyed NRLM designated fuel that they received.[248] We would also need to require that all parties handling dyed or undyed NRLM diesel fuel maintain records and submit reports demonstrating that the volume of NRLM designated fuel that they received was sold for use in nonroad, locomotive or marine diesel engines or transferred with the same designation to another fuel distributor. These requirements would be applied on an annual basis, providing fuel distributors with flexibility to shift fuel designated for one use to the other market and vice versa to address short term supply fluctuations of each fuel but still maintain overall program integrity.

Given the large number of entities involved in distributing diesel fuel and the number of transactions, there are a number of serious practical concerns regarding the enforceability of such an approach. Under the baseline approach described above, enforcement is focused on the roughly 128 refineries producing either highway or NRLM diesel fuel. This designation and track approach would add the various entities in the distribution system. In order to improve the chances of effectively enforcing the program, we would at a minimum have to limit the scope of the entities involved to bulk terminals and entities upstream. Thus, all NRLM diesel fuel would have to exhibit visible evidence of dye after leaving a large bulk terminal. Even with this limitation, there would be as many as 100 pipelines and 1000 terminals reporting. Enforcement of such an approach would be difficult because to determine whether inappropriate changes in designation occurred by a given entity, the records of each entity from which it received fuel and to which it sent fuel over the course of an entire year would also have to be compared. An electronic reporting mechanism would likely have to be set up to facilitate reporting and to track the volumes of fuel received and shipped out by each entity in the distribution system down to the terminal. If any entity in the distribution system were unable to verify through their records that they distributed the same amount or more of NRLM fuel as they took in with this designation, then they, not the refiners, would be presumed liable for violating the provisions of the highway

[248] If the volume of dyed NRLM fuel exceeded the designated volume, this would imply that some highway 500 ppm fuel was dyed. This would not compromise the required 80/20 split between 15 ppm and 500 ppm fuel under the highway program, although the total social cost of producing the fuel would be higher.

rule. Therefore, in addition to our concerns of ensuring compliance, we invite comment on the appropriateness of shifting the compliance burden for tracking fuel volumes, maintaining records, reporting to the Agency, and responding to enforcement audits from the refiners to the downstream parties, particularly since many of these entities are small businesses.

In addition to the number of entities involved and transactions needing to be tracked, there are a number of complications which would make such an approach difficult to implement. First, due to contamination in the distribution system that results in some product being downgraded from one grade to another in the distribution system, in actuality the volumes of fuel designated at the refinery and those downstream will likely never match. Some means of addressing this situation would have to be developed which did not allow fuel produced as NRLM fuel to be subsequently sold as highway fuel. Second, kerosene will be blended into NRLM diesel fuel in northern areas during the winter months. It is difficult to understand how refiners would be able to designate portions of this fuel as NRLM fuel or highway fuel at the refinery gate given its many other uses. Therefore, this would further disrupt the volume reconciliation. Third, it would not always be entirely clear who should be the entity responsible for compliance, recordkeeping, and reporting. In many cases in the distribution system there are entities who have custody of the fuel while a variety of other entities maintain ownership. A means of sorting out who the responsible party was under such circumstances would have to be determined.

One of the advantages of the proposed baseline approach is that once 500 ppm fuel leaves the refinery gate, the distribution system has complete flexibility to shift it to either the highway or the NRLM markets to respond to changing market conditions. Conversely, as discussed above, one of the main advantages of the designate and track approach is that it allows refiners complete flexibility to modify their relative production of 15 ppm and 500 ppm fuel by their choice of designations (highway or NRLM). However, the market will demand a certain volume of highway fuel and NRLM fuel, and these decisions will be made downstream. If the market demands more highway diesel fuel than what the refiners designated as highway on an annual basis, then under the designate and track approach the terminals will be restricted from responding to this market change. They could shift NRLM fuel into the highway market on a temporary basis, but by the end of the year, they would have to be able to reconcile their highway and NRLM volumes. Given the refiner's inability to predict future demand precisely, and their economic incentive to produce as little 15 ppm diesel fuel as possible, there is a real possibility that some terminals could find themselves in a noncomplying situation. Were this to occur, a terminal would be faced with two difficult choices. They could stop shipping highway diesel fuel, in which case they would not only fail to deliver on their contracts to their customers, but would also constrain highway diesel fuel supply, raising market prices. Or, they could continue to respond to market pressure and sell additional volumes of fuel designated as NRLM into the highway market. In this case, they would risk significant non-compliance penalties from EPA, were we able to detect the violation. Thus, we are concerned that the designate and track approach could result in either widespread noncompliance or disruption of the fuel distribution system.

We are also concerned that the designate and track approach would not maintain the benefits and integrity of the highway program. Nearly a third of all non-highway distillate today is produced to the highway specifications due primarily to limitations in the distribution system.

The sulfate PM and SO2 emission benefits predicted from the highway rule, and the assumptions with respect to program cost and fuel availability, were all based on the assumption that 80% of this spillover volume would comply with the 15 ppm highway standard and would be available for highway use if needed. Under the proposed dye approach, in the future this "spillover" from the highway market could technically be dyed at the refinery gate to avoid compliance with the 2006 highway standards. However, our expectation is that the majority of the spillover today would continue into the future as it would be costly to significantly change the current distribution practices. While the dye approach would not ensure this and spillover could decline, it would be unlikely to drop significantly. Similarly, the proposed baseline approach would maintain spillover at historical rates (either 2003-5 the average level or June 1, 2006 - May 31, 2007 level). However, under the designate and track approach, wherever undyed 500 ppm was distributed as a grade of fuel, the prior spillover volume could instead be designated as NRLM fuel, and would no longer be subject to the highway program standards (i.e., 80 percent of it would no longer have to meet the 15 ppm sulfur standard.). The segregation and associated cost that previously led to spillover would be gone. As a result, the benefits projected from this fuel volume under the highway rule would be reduced. Furthermore, with the reduced volume of 15 ppm fuel produced, we would need to reevaluate whether sufficient 15 ppm fuel would still be available in all parts of the country for the vehicles that would need it. The areas where availability of 15 ppm fuel would be of greatest concern would be those areas where 500 ppm fuel would be distributed and spillover would decline under the designate and track approach. The enforcement concerns cited in the paragraphs above only serve to heighten this concern.

EPA requests comments on the practical viability of this approach. In addition to the issues noted above, we specifically request comments on the following:

1) What would be the impacts of this approach on fuel distributors?
2) What information would need to be kept and/or reported?
3) How might the required reports be automated in a common, electronic format?
4) How often should reports be required (e.g., annually, quarterly, each batch if electronically)?
5) How might the record keeping requirements be combined with those already required by the U.S. Internal Revenue Service?
6) How would the record keeping requirements work for pipelines and certain terminals that handle fuel without taking ownership and that do not control the decision to dye certain diesel fuel prior to sale?
7) How might the IRS records for refiners, importers and distributors be used as an independent check on the volumes of undyed diesel fuel handled which are eventually dyed and which are sold undyed?
8) What would be the cost associated with the tracking, record keeping and reporting?
9) Could the industry utilize independent auditors to simplify EPA's enforcement oversight?
10) Could refiners feasibly be responsible to ensure the necessary volumes are dyed downstream at the terminal rather than placing the responsibility and liability with the fuel distributors?

11) What changes could be made to the program to avoid losing the benefits of the highway program (e.g., avoid loss in production of 15 ppm attributable to the spillover volume)?

ii. Designate and Track as a Refiner's Option in Addition to the Baseline Approach

Several refiners indicated that the designate and track approach should be considered as an option in addition to the baseline approach. Including the designate and track approach as a refiner's option, however, would significantly alter the design and implications of the approach.

With such an approach, no longer could compliance be determined simply on the basis of whether a terminal dyed at least as much volume of diesel fuel as the volume received designated as NRLM 500 ppm fuel, since the dyed diesel fuel could have been produced under either the non-highway baseline approach or the designate and track approach. In a situation where volumes produced under the designate and track approach are fungibly distributed with volumes produced under the baseline approach, there is no clear way to identify whether dyed volumes have been accurately reconciled under the designate and track approach, risking significant loss in the benefits expected from the highway program.

For example, assume a terminal receives a certain volume of undyed diesel fuel and 30% of it was originally designated by the refinery as NRLM under the designate and track approach. The remaining 70% would have been produced by refineries using the non-highway baseline approach. Some significant portion of the 70% produced by refineries under the baseline approach would have been produced subject to the 500 ppm standard for the NRLM market, not the standards for highway market, and produced with the expectation that it could later be dyed at the terminal. If the terminal dyes only 30% of the entire volume it receives, there is every expectation that some or even all of that 30% could have been produced by refineries using the baseline approach, and should not be counted towards the volume reconciliation under the designate and track approach. If all of the 30% of dyed diesel fuel was produced by refineries using the baseline approach, then the terminal would have effectively sold into the highway market all of the fuel received as NRLM under the designate and track approach.

Thus, in order to allow for volumes to be reconciled using such an approach, we concluded that fuel distributors would have to track which refinery or importer the fuel came from and how they disposed of the fuel for that refinery or importer, in addition to whether it was NRLM or highway. Thus, allowing the designate and track approach as a refiner's option would add one more layer of complexity to the tracking, recordkeeping, and reporting.

The following example explains how the approach could work in theory. Over the course of a year, a terminal receives 6 million gallons of 500 ppm diesel fuel identified as baseline fuel from refinery A, 2 million gallons of 500 ppm diesel fuel designated as "designate and track" NRLM fuel from refinery B, and 2 million gallons of 500 ppm diesel fuel designated as "designate and track" highway fuel from refinery B. At the end of the year, the terminal would have had to have dyed at least 2 million gallons of the fuel it received from refinery B and delivered it to or on behalf of that refinery as dyed NRLM. (If they do not deliver the fuel back to the entity that designated the fuel, then the dyed fuel could have been baseline fuel from refinery A, and we could not enforce the dyeing of the designate and track fuel volume from refinery B.) The terminal would need to do this separately for each refinery or importer from which it received designate and track diesel fuel.

Based on the above discussion, we believe that in order to have an enforceable program, only those refineries and importers who maintain ownership of the fuel all the way through the pipeline and terminal could take advantage of the option to designate and track their fuel. This could be a very small subset of refiners since they would have to maintain ownership of all of their NRLM diesel fuel distributed through all of its distribution pathways to the point where the fuel is dyed. If this were a very small subset, then it would raise questions as to whether the flexibility of this approach would be worth the added program and enforcement complexity.

Since the pipelines and terminals in this situation are basically providing a service to these refineries and importers, transporting their fuel and dyeing it for them, a different responsibility and liability scheme could be considered. Instead of the fuel distributors being solely responsible for recordkeeping and reporting to the Agency and liable for any violations, it might be possible to leave this burden with the refiner. The refiner could be responsible for ensuring that they took delivery from a terminal of at least as much dyed NRLM diesel fuel as they sent undyed NRLM to that terminal from their refinery gate. The refiner would be responsible for collecting and maintaining the records from the various points in the distribution system to demonstrate compliance and to submit an annual report demonstrating compliance. At the same time EPA would have to be able to verify the refiner's report and as a result, fuel distributors may still have to maintain records.

For the baseline approach to exist simultaneously with the designate and track approach, a refinery or importer would have to choose which approach to utilize and maintain that approach. We could consider allowing the refinery to change approaches on a year to year basis, as with the baseline and dye alternatives.

EPA requests comment on the designate and track approach as a refinery's option and whether it could be enforced as described above. EPA specifically requests comment on:

1) The advantages and disadvantages of placing the recordkeeping, reporting, and liability burden on the refinery of the designate and track approach if it is an option along with baseline approach;
2) If this responsibility were not place on the refiners, what level of voluntary participation would occur among fuel distributors (e.g., pipelines and terminals) and how might EPA structure a viable enforcement oversight program;
3) What level of voluntary refinery participation would occur and whether it warrants the added program complexity;
4) The extent to which this approach might reduce 15 ppm highway diesel production (i.e., reduced spillover to non-highway markets)
5) What would be the cost associated with the tracking, record keeping and reporting?

C. Hardship Provisions for Qualifying Refiners

1. Hardship Provisions for Qualifying Small Refiners

In developing our proposed off-highway diesel sulfur program, we evaluated the need and the ability of refiners to meet the 500 and 15 ppm standards as expeditiously as possible. We believe it is feasible and necessary for the vast majority of the program to be implemented in the proposed time frame to achieve the air quality benefits as soon as possible. Based on information available from small refiners and others, we believe that refineries owned by small businesses generally face unique hardship circumstances, compared to larger refiners. Thus, as discussed below, we are proposing several special provisions for refiners that qualify as "small refiners" to reduce the disproportionate burden that nonroad diesel sulfur requirements would have on these refiners.[249]

a. Qualifying Small Refiners

EPA is proposing several special provisions that would be available to companies approved as small refiners. The primary reason for these provisions is that small refiners generally lack the resources available to large companies that help large companies, including those large companies that own small-capacity refineries, to raise capital for investing in desulfurization equipment, such as shifting of internal funds, securing of financing, or selling of assets. Small refiners are also likely to have more difficulty in competing for engineering resources and completing construction of the needed desulfurization equipment in time to meet the standards proposed today.

Since small refiners are more likely to face hardship circumstances than larger refiners, we are proposing temporary provisions that would provide additional time to meet the sulfur standards for refineries owned by small businesses. This approach would allow the overall program to begin as early as possible, avoiding the need for delay in order to address the ability of small refiners to comply.

i. Regulatory Flexibility for Small Refiners

As explained in the discussion of our compliance with the Regulatory Flexibility Act in Section X.C and in the Initial Regulatory Flexibility Analysis in Chapter 11 of the Draft RIA, we considered the impacts of the proposed regulations on small businesses. Most of our analysis of small business impacts was performed as a part of the work of the Small Business Advocacy Review (SBAR) Panel convened by EPA, pursuant to the Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA). The final report of the Panel is available in the docket for this proposed rule.

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[249] The proposed small refiner provisions would not apply to importers, as the burden from capital expenditures for physical refinery improvements are not imposed on importers.

For the SBREFA process, EPA conducted outreach, fact-finding, and analysis of the potential impacts of our regulations on small businesses. Based on these discussions and analyses by all panel members, the Panel concluded that small refiners in general would likely experience a significant and disproportionate financial hardship in reaching the objectives of the proposed nonroad diesel fuel sulfur program.

One indication of this disproportionate hardship for small refiners is the relatively high cost per gallon projected for producing nonroad diesel fuel under the proposed program. Refinery modeling of refineries owned by refiners likely to qualify as small refiners, and of non-small refineries, indicates significantly higher refining costs for small refiners. Specifically, we project that without special provisions, refining costs for small refiners on average would be about 5.5 cents per gallon compared to about 4.0 cents per gallon for non-small refiners.

The Panel also noted that the burden imposed on the small refiners by the proposed sulfur standards may vary from refiner to refiner. Thus, the Panel recommended more than one type of burden reduction measure so that most if not all small refiners could benefit. We have continued to consider the issues raised during the SBREFA process and have decided to propose each of the provisions recommended by the Panel.

ii. Rationale for Small Refiner Provisions

Generally, we structured these proposed provisions to reduce the burden on small refiners while expeditiously achieving air quality benefits and ensuring that the availability of 15 ppm nonroad diesel fuel would coincide with the introduction of 2011 model year nonroad diesel engines and equipment. We believe the proposed special provisions for small refiners are necessary and appropriate.

First, the proposed compliance schedule for the nonroad diesel program, combined with flexibility for small refiners, would achieve the air quality benefits of the program as soon as possible, while helping to ensure that small refiners will have adequate time to raise capital for new or upgraded fuel desulfurization equipment. Most small refiners have limited additional sources of income beyond refinery earnings for financing and typically do not have the financial backing that larger and generally more integrated companies have. Therefore, they can benefit from additional time to accumulate capital internally or to secure capital financing from lenders.

Second, we recognize that while the sulfur levels in this proposed program can be achieved using conventional refining technologies, new technologies are also being developed that may reduce the capital and/or operational costs of sulfur removal. Thus, we believe that allowing small refiners some additional time for newer technologies to be proven out by other refiners would have the added benefit of reducing the risks faced by small refiners. The added time would likely allow for small refiners to benefit from the lower costs of these improvements in desulfurization technology (e.g., better catalyst technology or lower-pressure hydrotreater technology). This would help to offset the financial burden facing small refiners.

Third, providing small refiners more time to comply would increase the availability of engineering and construction resources. Most refiners would need to install additional processing equipment to meet the nonroad diesel sulfur requirements. We anticipate that there may be significant competition for technology services, engineering resources, and construction management and labor. In addition, vendors will be more likely to contract their services with the larger refiners first, as their projects will offer larger profits for the vendors. Temporarily delaying compliance for small refiners would spread out the demand for these resources and probably reduce any cost premiums caused by limited supply.

We discuss below the provisions we are proposing to minimize the degree of hardship for small refiners. With these provisions we are confident about going forward with the 500 ppm sulfur standard for NRLM diesel fuel in 2007 and the 15 ppm sulfur standard for nonroad diesel fuel in 2010 for the rest of the industry. Without small refiner flexibility, EPA would have to consider delaying the overall program until the burden of the program on many small refiners were diminished, which would delay the air quality benefits of the overall program. By providing temporary relief to small refiners, we are able to adopt a program that expeditiously reduces off-highway diesel sulfur levels in a feasible manner for the industry as a whole.

iii. Limited Impact of Small Refiner Options on Program Emissions Benefits

Small refiners that choose to make use of the delayed nonroad diesel sulfur requirements would also delay to some extent the emission reductions that would otherwise have been achieved. However, the overall impact of these postponed emission reductions would be small, for several reasons.

First, small refiners represent only a fraction of national non-highway diesel production. Today, refiners that we expect would qualify as small refiners represent only about 6 percent of all high-sulfur diesel production. Second, the proposed delayed compliance provisions described below would affect only engines without new emission controls. During the first step to 500 ppm NRLM fuel, small refiner nonroad fuel could be well above 500 ppm, but the new advanced engine controls would not yet be required. During the second step to 15 ppm nonroad diesel fuel, equipment with the new controls would be entering the market, but use of the 500 ppm small refiner fuel would be restricted to older engines without the new controls. There would be some loss of sulfate PM control in the older engines that operated on higher sulfur small refiner fuel, but no effect on the major emission reductions that the proposed new engine standards would achieve starting in 2011. Finally, because small diesel refiners are generally dispersed geographically across the country, the limited loss of sulfate PM control would also be dispersed.

One proposed small refiner option would allow a modest 20% relaxation in the gasoline sulfur interim standards for small refiners that produce all nonroad diesel fuel at 15 ppm by June 1, 2006. To the extent that small refiners elected this option, a small loss of emission control from Tier 2 gasoline vehicles that used the higher sulfur gasoline could occur. We believe that such a loss of control would be very small. A very few small refiners would be in a position to use this provision. Further, the relatively small production of gasoline with slightly higher sulfur levels should have no measurable impact on the emission of new Tier 2 vehicles, even if the likely "blending down" of sulfur levels did not occur as this fuel mixed with lower sulfur fuel during distribution. This provision would also maintain the maximum 450 ppm gasoline sulfur per-gallon cap standard in all cases, providing a reasonable sulfur ceiling for any small refiners making use of this provision.

b. How Do We Define Small Refiners for Purposes of the Hardship Provisions?

The definition of small refiner for the proposed nonroad diesel program is basically the same as our small refiner definitions in the Tier 2/Gasoline Sulfur and Highway Diesel rules. A small refiner must demonstrate that it meets both of the following criteria:

- No more than 1,500 employees corporate-wide, based on the average number of employees for all pay periods from January 1, 2002 to January 1, 2003.

- A corporate crude oil capacity less than or equal to 155,000 barrels per calendar day (bpcd) for 2002.

As with the earlier fuel sulfur programs, the dates for the employee count and for calculation of the crude capacity represent the latest complete years prior to the issuing of the proposed rule.

In determining the total number of employees and crude oil capacity, a refiner must include the number of employees and crude oil capacity of any subsidiary companies, any parent company and subsidiaries of the parent company, and any joint venture partners. We define a subsidiary of a company to mean any subsidiary in which the company has a 50 percent or greater ownership interest. However, we are proposing that a refiner be eligible for small refiner status if it is owned and controlled by an Alaska Regional or Village Corporation organized under the Alaska Native Claims Settlement Act (43 U.S.C. 1626), regardless of number of employees and crude oil capacity. Such an exclusion would be consistent with our desire to grant relief from regulatory burden to that part of the industry that can least afford compliance. We believe that very few refiners, probably only one, would qualify under this provision. Similarly, we are proposing to incorporate this exclusion into the small refiner provisions of the highway diesel and gasoline sulfur rules, which did not address this issue.

As with the earlier fuel sulfur rules, we are proposing that a refiner that restarts a refinery in the future may be eligible for small refiner status. Thus, a refiner restarting a refinery that was shut down or non-operational between January 1, 2002 and January 1, 2003 could apply for small refiner status. In such cases, we would judge eligibility under the employment and crude oil capacity criteria based on the most recent 12 consecutive months unless we conclude from data provided by the refiner that another period of time is more appropriate. Companies with refineries built after January 1, 2002 would not eligible for the small refiner hardship provisions.

2. The Effect of Financial Transactions on Small Refiner Status and Small Refiner Relief Provisions

During the implementation of the gasoline sulfur and highway diesel sulfur programs, several refiners have raised concerns about how various kinds of financial transactions would affect implementation of the small refiner fuel sulfur provisions. The kind of transactions typically involve refiners with approved small refiner status that are involved in potential or actual sales of the small refiner's refinery, or involve the purchase by the small refiner of another refinery or other non-refining asset. We believe that these concerns are also relevant to the small refiner provisions proposed below for the nonroad diesel sulfur program.

a. Large Refiner Purchasing a Small Refiner's Refinery

One situation involves a "non-small" refiner that wishes to purchase a refinery owned by an approved small refiner. The small refiner may not have completed or even begun refinery upgrades to meet the long-term fuel sulfur standards, since it is making use of the special small refiner relief provisions. This situation is of most concern where the purchase is to take place near or after the beginning of the gasoline or highway diesel sulfur programs. Under the existing gasoline sulfur and highway diesel sulfur programs, once such a purchase is completed, the "non-small" purchaser would not have the benefit of the small refiner relief provisions that had applied to the previous owner.

The purchasing refiner would have to perform the necessary upgrades to meet the "non-small" sulfur standards. As the gasoline sulfur and highway diesel sulfur provisions exist today, such a refiner would be left with very little or (if the respective fuel sulfur control program has already begun) no lead time for compliance. The refiners that have raised this issue have claimed that refiners in this situation would not be able to comply with the "non-small refiner" standards upon acquisition of the new refinery. These refiners claim that this could prevent them from purchasing a refinery from a small refiner and, as a result, this would severely limit the ability of small refiners to sell such an asset. The refiners that have raised this issue have said that some sort of "grace period" of additional lead time before the non-small refiner sulfur standards take effect would address this issue.

We believe these concerns are valid and are proposing that an appropriate period of lead time for compliance with the nonroad diesel sulfur requirements be provided where a refiner purchases any refinery owned by small refiner, whether by purchase of the refinery or purchase of the small refiner entity. We propose that a refiner that acquires a refinery from an approved small refiner be provided 24 additional months from the date of the completion of the purchase transaction (or until the end of the applicable small refiner relief interim period if it is within 24 months -- June 1, 2010 for 500 ppm fuel and June 1, 2014 for 15 ppm fuel). During this interim period, production at the newly-acquired refinery could remain at the interim sulfur levels that applied to that refinery for the previous small refiner owner under the small refiner options discussed below. At the end of this period, the refiner would need to comply with the "non-small refinery" sulfur standards.

We expect that in most if not all cases, the proposed 24 months of additional lead time would be sufficient for the new refiner-owner to accomplish the necessary engineering, permitting, construction, and start-up of the necessary desulfurization project, since planning for this could be expected to be a part of any purchase decision. If a refiner nonetheless believed that the technical characteristics of its planned desulfurization project would require additional lead time, the refiner could apply for additional time and EPA would consider such requests on a case-by-case basis. Such an application would be based on the technical factors supporting the need for more time and include detailed technical information and projected schedules for engineering, permitting, construction, and startup. Based on information provided in such an application and other relevant information, EPA would decide whether additional time was technically necessary and, if so, how much additional time would be appropriate. As discussed above, in no case would compliance dates be extended beyond the time frame of the applicable small refiner relief provisions (June 1, 2010 for 500 ppm fuel and June 1, 2014 for 15 ppm fuel).[250]

During the 24 months additional lead time (and any further lead time approved by EPA for the purchasing refiner), all existing small refiner provisions and restrictions, as described below, would also remain in place for that refinery. This would include the per-refinery volume limitation on the amount of nonroad diesel that could be produced at the small refiner standards. There would be no adverse environmental impact of this provision, since the small refiner would already have been provided relief prior to the purchase and this provision would be no more generous.

b. Small Refiner Losing Its Small Refiner Status

A second situation involves a refiner with approved small refiner status that later loses its small refiner status because it exceeds the small refiner criteria. In the existing gasoline sulfur and highway diesel sulfur programs, an approved small refiner that exceeds 1500 employees due to merger or acquisition would lose its small refiner status. (We also intended for refiners that exceeded the 155,000 barrel per calendar day crude capacity limit due to merger or acquisition to lose its small refiner status and we are proposing below to amend the regulations to reflect that criterion as well.) This includes exceedences of the criteria caused by acquisitions of assets such as plant and equipment, as well as acquisitions of business entities.

Our intent in the gasoline and highway diesel sulfur programs, as well as the proposed nonroad diesel sulfur program, has been and continues to be to reserve the small refiner relief provisions for a small subset of refiners that generally tend to face the kinds of special challenges discussed above. At the same time, it is also our intent to avoid stifling normal business growth among small refiners. Therefore, we designed our existing regulations, as well as the proposed regulations, to disqualify a refiner from small refiner status when it exceeds the small refiner criteria through its involvement in transactions such as being acquired by or merging with another entity or through the small refiner itself purchasing another entity or assets from another entity. However, as in the existing regulations, we are proposing that if an approved small refiner were to exceed the criteria without merger or acquisition, it would keep its small refiner status.

[250] This process would be similar to the general hardship provisions of the existing gasoline sulfur and highway diesel sulfur programs and proposed today for nonroad diesel fuel. However, the focus here would be simply on the lead time needed for the technical upgrades and would not consider any claimed financial hardship.

Consistent with our intent in the earlier fuel sulfur programs to limit the use of the small refiner hardship provisions, we also intended in the gasoline sulfur and highway diesel sulfur programs for an exceedence of the other small refiner criterion -- a limit of 155,000 barrels per calendar day of crude capacity -- due to merger or acquisition to be grounds for disqualifying a refiner's small refiner status. However, we inadvertently failed to include this second criterion as grounds for disqualification. In today's action, we propose to resolve this error by adding the crude capacity limit to the employee limit in this context for both the gasoline sulfur and highway diesel sulfur programs, to begin January 1, 2004. Thus, a refiner exceeding either criterion due to merger or acquisition would lose its small refiner status.

We recognize that a small refiner that loses its small refiner status because of a merger or acquisition would face the same type of lead time concerns in complying with the non-small refiner standards as would a non-small refiner that acquired a small refiner's refinery, as discussed above. Therefore, we propose that the additional lead time proposed above for non-small refiners purchasing a small refiner's refinery also apply this situation. Thus, this additional lead time would apply to any refineries, existing or newly-purchased, that had previously been subject to the small refiner program, but would not apply to a newly-purchased refinery that is subject to the non-small refiner standards. Again, there would be no adverse environmental impact because of the newly-purchased small refiner's pre-existing relief provisions.

The issues discussed in this subsection apply equally to the gasoline sulfur and highway diesel sulfur programs. Thus, we are also proposing that the same provisions relating to additional lead time in cases of financial transaction be applied to the small refiner programs in the earlier fuel sulfur programs. Because these proposed provisions for the existing fuel sulfur programs are independent of today's nonroad diesel fuel program, we may choose to finalize them separately from and earlier than the identical provisions proposed for today's nonroad rule. If this occurs, we will seek to finalize nonroad diesel fuel provisions that are identical or as similar as appropriate to those finalized for the gasoline sulfur and highway diesel program.

In addition, we are inviting comment on several other related provisions we are considering:

(1) We propose above that a small refiner that loses its small refiner status be granted 24 months of lead time at its existing refineries. Should such a small refiner instead be allowed to "grandfather in" its existing small refiner relief program for its existing refinery or refineries? An argument can be made that in purchasing a new refinery or other assets, the small refiner would no longer demonstrate the kind of financial hardship that was the basis for general small refiner relief. However, we also do not intend to stifle normal growth of small refiners, and "grandfathering in" the small refiner interim relief program would have no environmental impact, since would merely continue an existing program at that refinery.

(2) If a small refiner exceeds the small refiner criteria due to the purchases of a non-small refiner, should the proposed additional lead time apply to that refinery? Or should the refiner be required to meet the non-small refiner standards on schedule

at the "new" refinery, since the previous owner could be assumed to have anticipated the new standards and taken steps to accomplish this prior to the purchase?

c. What Options Are Available for Small Refiners?

We propose several provisions intended to reduce the burdens on small refiners discussed above as well as to encourage their early compliance whenever possible. As described below, these proposed small refiner provisions consist of additional time for compliance and, for small refiners that choose to comply earlier than required, the option of either generating diesel sulfur credits or receiving a limited relaxation of gasoline sulfur requirements.

i. Delays in Nonroad Fuel Sulfur Standards for Small Refiners

We propose that small refiners be allowed to postpone reducing sulfur in nonroad locomotive and marine diesel fuel until June 1, 2010. As described earlier, we are proposing that all refiners producing nonroad diesel fuel be provided significant lead time for making the capital and operational investments to produce 15 ppm fuel, including about 3 years before the 500 ppm requirement would become effective, and 3 additional years before 15 ppm was required- June 1, 2007 through May 31, 2010, when 500 ppm fuel could be produced. While this leadtime would be useful for small and non-small refiners alike, we believe that in general small refiners would still face disproportionate challenges, and the proposed delay in the first step of control for small refiners would help mitigate these challenges.

Then, beginning June 1, 2010, when the second step of the proposed base program would require 15 ppm fuel for other refiners for nonroad diesel fuel, we propose that small refiners be required to meet a 500 ppm sulfur standard for NR diesel fuel. We propose that this interim standard be effective for four years (until June 1, 2014), after which small refiners would meet the 15 ppm sulfur standard for nonroad diesel fuel. As for other refiners, the small refiner standard for locomotive and marine diesel fuel would remain at 500 ppm. Since new engines with sulfur sensitive emission controls would begin to become widespread during this time, small refiners would need to segregate the 500 ppm NR fuel and supply it only for use in pre-2011 nonroad equipment or in locomotives or marine engines. Section VIII below discusses the requirements for product transfer documents (PTDs) associated with the production of 500 ppm NR fuel by small refiners during this period.

The following table illustrates the proposed small refiner NRLM and NRdiesel standards as compared to the standards proposed in the base nonroad diesel program. (For simplicity, the proposed locomotive and marine diesel standards for small and non-small refiners described above do not appear in the table.)

TABLE IV-4 – PROPOSED SMALL REFINER NONROAD DIESEL SULFUR STANDARDS, PPM[a]

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015+
Non-Small Refiners	--	500	500	500	15	15	15	15	15	15
Small Refiners	**--**	**--**	**--**	**--**	**500**	**500**	**500**	**500**	**15**	**15**

Notes:
[a] New standards would take effect in June of the applicable year.

We also request comment on a slightly different compliance schedule that would require small refiners to produce 15 ppm nonroad diesel fuel beginning June 1, 2013, one year earlier than proposed above. Such a schedule would align the end of the interim small refiner provisions with the end of the proposed phase-in for nonroad engines and equipment and eliminate higher sulfur nonroad fuel from the distribution system by the time all new nonroad diesel engines required 15 ppm fuel.

The proposed delayed compliance schedule for small refiners is intended to compensate for the relatively higher compliance burdens on these refiners. It is not intended as an opportunity for those refiners to greatly expand their production of uncontrolled diesel fuel (2007-2010) or 500 ppm sulfur fuel (2010-2014). To help ensure that any significant expansion of refining capacity that a small refiner might undertake in the future would be accompanied by an expansion of desulfurization capacity, we are proposing that small refiners producing higher sulfur fuel limit that production to baseline volume levels.

Specifically, during the first step of the diesel program to 500 ppm (June 2007-June 2010), a small refiner could produce uncontrolled NRLM diesel fuel up to the proposed non-highway baseline for that refiner less any marked heating oil it produces, refer to sub-section B above for an explanation of this baseline. Any diesel fuel produced over its non-highway baseline would be subject to the 500 ppm standard applying to other refiners. Similarly, from June 1, 2010 through May 31, 2014, a small refiner could produce nonroad diesel fuel at 500 ppm up to the non-highway baseline less any volume of heating oil and marked locomotive and marine diesel fuel it produced. Fuel produced in excess of this volume would be subject to the 15 ppm nonroad diesel standard.

ii. Options to Encourage Earlier Compliance by Small Refiners

Some small refiners have indicated that they might find it necessary to produce fuel meeting the nonroad diesel sulfur standards earlier than required by the small refiner program described above, for a variety of reasons. For some small refiners, the distribution systems might limit the number of grades of diesel fuel that will be carried. Others might find it economically advantageous to make 500 ppm or 15 ppm fuel earlier so as not to lose market share. At least one small refiner has indicated that it might decide to desulfurize its NR pool at the same time as it desulfurized its highway diesel fuel, in June of 2006, due to limitations in its distribution system and to take advantage of economies of scale. Given these situations, we propose that small refiners be able to choose between two mutually exclusive options, as an incentive for early compliance.

The first proposed option would make the diesel sulfur credit banking and trading program discussed earlier in this section fully applicable to small refiners. A small refiner could generate diesel sulfur credits for production of 500 ppm NRLM diesel fuel prior to June 1, 2010, and for production of 15 ppm nonroad fuel from June 1, 2010 through May 31, 2012. The specifics of the credit program are described above in subsection B.2, including how they would be applicable to small refiners. Generating and selling credits could provide funds to defray the costs of early nonroad compliance.

The second proposed option would apply to a small refiner that produced all of its NRLM diesel production at 15 ppm by June 1, 2006 and elected not to use the provision described above to earn NRLM sulfur credits for this early compliance. (As for other refiners, locomotive and marine fuel sulfur would not be controlled in 2006 and could meet the 500 ppm standard beginning June 1, 2007.) Such a refiner would receive a modest revision in its interim small refiner gasoline sulfur standards, starting January 1, 2004. Specifically, the applicable small refiner annual average and per-gallon cap gasoline standards would be revised upward by 20 percent for the duration of the small refiner gasoline sulfur interim program (i.e., through either 2007 or 2010, depending on whether the refiner had extended its participation in the gasoline sulfur interim program by complying with the highway diesel standard at the beginning of that program (June, 2006, as provided in 40 CFR 80.552(c))). However, in no case could the per-gallon cap exceed 450 ppm, the highest level allowed under the gasoline sulfur program.

We believe it is very important to link any such temporary relaxation of a small refiner gasoline sulfur interim sulfur standards with environmental benefit of early desulfurization of a significant volume of NRLM diesel fuel. Thus, we propose that a small refiner wishing to use this option must produce a minimum volume of NRLM diesel fuel at 15 ppm by June 1, 2006. Each participating small refiner would need to produce a volume of 15 ppm fuel that was at least 85% of the volume represented by its non-highway distillate baseline percentage. If the refiner began to produce gasoline in 2004 at the higher interim standard of this provision but then either failed to meet the 15 ppm standard for its NRLM fuel by June 1, 2006 or failed to meet the 85% minimum volume requirement, the original small refiner interim gasoline sulfur standard applicable to that refiner would be reinstated. In addition, the refiner would need to compensate for the higher gasoline levels that it had enjoyed by purchasing gasoline sulfur credits or producing an equivalent volume of gasoline below the required sulfur levels.

Under this option, a small refiner could in effect shift some funds from its gasoline sulfur program to accelerate desulfurization of nonroad diesel fuel. Given the environmental benefit that would result from the production of 15 ppm diesel fuel earlier than necessary, and the small potential loss of emission reduction under the gasoline sulfur program from fuel produced by the very few small refiners that we believe would qualify under this second option, we believe the environmental impact of this option would be neutral or positive.

d. How Do Refiners Apply for Small Refiner Status?

A refiner applying for status as a small refiner would provide EPA with several types of information by December 31, 2004. The detailed application requirements are summarized in Section VII.E.2 below. In general, a refiner would need to provide information about the following for the parent company and all subsidiaries at all locations: 1) the average number of employees for all pay periods from January 1, 2002 through January 1, 2003; 2) total corporate crude refining capacity; and 3) an indication of which small refiner option the refiner is likely to use (see subsection c. above). As with applications for relief under other rules, applications for small refiner status under this proposed diesel rule that were later found to contain false or inaccurate information would be void *ab initio*.

2. General Hardship Provisions

a. Temporary Waivers from Non-highway Diesel Sulfur Requirements in Extreme Unforseen Circumstances

We are proposing a provision which, at our discretion, would permit any domestic or foreign refiner to seek a temporary waiver from the nonroad, locomotive, or marine diesel sulfur standards under certain rare circumstances. This waiver provision is similar to provisions in the reformulated gasoline (RFG), low sulfur gasoline, and highway diesel sulfur regulations. It is intended to provide refiners short-term relief in unanticipated circumstances – such as a refinery fire or a natural disaster – that cannot be reasonably foreseen now or in the near future.

Under this provision, a refiner may seek permission to distribute nonroad, locomotive, or marine diesel fuel that does not meet the applicable 500 or 15 ppm sulfur standards for a brief time period. An approved waiver of this type could, for example, allow a refiner to produce and distribute diesel fuel with higher than allowed sulfur levels, so long as the other conditions described below were met. Such a request would be based on the refiner's inability to produce complying nonroad, locomotive or marine diesel fuel because of extreme and unusual circumstances outside the refiner's control that could not have been avoided through the exercise of due diligence. The request would also need to show that other avenues for mitigating the problem, such as purchase of credits toward compliance under the proposed credit provisions, had been pursued and yet were insufficient. As with other types of relief established in this rule, this type of temporary waiver would have to be designed to prevent fuel exceeding the 15 ppm standard from being used in 2011 and later model year nonroad engines.

The conditions for obtaining a nonroad diesel waiver are similar to those in the RFG, Tier 2 gasoline sulfur, and highway diesel regulations. These conditions are necessary and appropriate to ensure that any waivers that are granted are limited in scope, and that refiners do not gain economic benefits from a waiver. Therefore, refiners seeking a waiver would need to show that the waiver is in the public interest, that the refiner was not able to avoid the nonconformity, that it would make up the air quality detriment associated with the waiver, that it would make up any economic benefit from the waiver, and that it would meet the applicable diesel sulfur standards as expeditiously as possible.

b. Temporary Waivers Based on Extreme Hardship Circumstances

In addition to the provision for short-term relief in extreme unforseen circumstances, we are proposing a provision for relief based on extreme hardship circumstances that is very similar to those established in the gasoline sulfur and highway diesel sulfur programs. Under the gasoline sulfur program, we granted waivers to four refiners. Each waiver was designed for the specific situation of that refiner. Under the highway diesel program, we have received two applications for which the decisions are still pending.

As in the earlier rules, we have considered whether any refiners would face particular difficulty in complying with the standards in the lead time provided. As described earlier in this section, we concluded that in general small refiners would experience more difficulty in complying with the standards on time because they have less ability to raise the capital necessary for refinery investments, face proportionately higher costs because of poorer economies of scale, and are less able to successfully compete for limited engineering and construction resources. However, it is possible that other refiners that are not small refiners would also face particular difficulty in complying with the sulfur standards on time. Therefore, we are including in this proposed rule a provision which allows us, at our discretion, to grant temporary waivers from the proposed nonroad diesel sulfur standards based on a showing of extreme hardship circumstances.

The extreme hardship provision allows any domestic or foreign refiner to request a waiver from the sulfur standards based on a showing of unusual circumstances that result in extreme hardship and significantly affect a refiner's ability to comply with either the 500 ppm or 15 ppm sulfur diesel standards by either June 1, 2007 or June 1, 2010, respectively. EPA would evaluate each application on a case-by-case basis, considering the factors described below. If EPA approved a hardship application, we could provide refiners with relief similar to the provision for small refiners. That is, we might provide an allowance for producing high sulfur fuel during the 2007-2010 period when the 500 ppm cap is in effect, or an allowance for producing 500 ppm fuel for a period of time after June 1, 2010. Depending on the situation of the refiner, such approved delays in meeting the sulfur requirements might be shorter than those allowed for small refiners i.e., 3 years for high sulfur fuel beginning June 1, 2007 and 4 years for 500 ppm fuel beginning June 1, 2010, but would not be longer. In such an approval, we would expect to impose appropriate conditions to assure the refiner is making its best effort and to minimize any loss of emission control from the program. As with other relief provisions established in this rule, any waiver under this provision would be designed to prevent fuel exceeding the 15 ppm standard from being used in 2011 and later model year nonroad engines.

Providing short-term relief to those refiners that need additional time because they face hardship circumstances facilitates adoption of an overall program that reduces NRLM diesel fuel sulfur to 500 ppm beginning in 2007, and nonroad diesel fuel sulfur to 15 ppm in 2010, for the majority of the industry. However, we do not intend for this waiver provision to encourage refiners to delay planning and investments they would otherwise make. We do not expect to grant temporary waivers that apply to more than approximately one percent of the national NRLM diesel fuel pool in any given year.

The regulatory language for today's action includes a list of the information that must be included in a refiner's application for an extreme hardship waiver. If a refiner fails to provide all the information, as specified in the regulations, as part of its hardship application, we can deem the application void. EPA may request additional information as needed. The following are some examples of the types of information that must be contained in an application:

- The crude oil refining capacity and fuel sulfur level(s) of each diesel fuel product at each of the refiner's refineries.
- Technical plan for capital equipment and operating changes to achieve future diesel fuel sulfur levels.
- The anticipated timing for the overall project the refiner is proposing and key milestones to ultimately produce 100 percent of NRLM diesel fuel at 500 ppm sulfur and 100 percent of its nonroad diesel fuel at 15 ppm sulfur.
- The refiner's capital requirements for each step of the proposed projects.
- Detailed plans for financing the project and financial statements demonstrating the nature of and degree of financial hardship and how the requested relief would mitigate this hardship. This would include a description of the overall financial situation of the company and its plans to secure financing for the desulfurization project (e.g., internal cash flow, bank loans, issuing of bonds, sale of assets, or sale of stock).
- Description of the market area for the refiner's diesel fuel products.
- A plan demonstrating how they would achieve the standards as quickly as possible, including a timetable for obtaining the necessary capital, contracting for engineering and construction resources, obtaining any necessary permits, and beginning and completing construction.

We would consider several factors in our evaluation of the hardship waiver applications. Such factors would include whether a refinery's configuration is unique or atypical; the proportion of non-highway diesel fuel production relative to other refinery products; whether the refiner, its parent company, and its subsidiaries are faced with severe economic limitations (for example, a demonstrated inability to raise necessary capital or an unfavorable bond rating); and steps the refiner has taken to attempt to comply with the standards, including efforts to obtain credits towards compliance. In addition, we would consider the total crude oil capacity of the refinery and its parent or subsidiary corporations, if any, in assessing the degree of hardship and the refiner's role in the diesel market. Finally, we would consider where the diesel fuel would be sold in evaluating the environmental impacts of granting a waiver.

This extreme hardship provision is intended to address unusual circumstances that should be apparent now or would emerge in the near future. Thus, refiners seeking additional time under this provision would have to apply for relief by June 1, 2005. We request comment on this date and whether a separate date would be appropriate for the second (15 ppm) step of the nonroad diesel program to 15 ppm. We would review and act on applications and, if a waiver is granted, would specify a detailed desulfurization schedule under the waiver. Typically, because of EPA's comprehensive evaluation both financial and technical information, action on hardship applications can take six or more months.

D. Should Any Individual States or Territories Be Excluded From This Rule?

1. Alaska

We propose that the diesel fuel sulfur standards - the 500 ppm cap for NRLM diesel fuel beginning June 1, 2007 and the 15 ppm cap for nonroad diesel fuel beginning June 1, 2010 - and the aromatics and cetane standards proposed today apply to the portion of Alaska served by the Federal Aid Highway System. However, we propose that Alaska's rural areas be excluded from these proposed fuel content standards. The engine standards proposed today would apply to all nonroad engines throughout Alaska. Consequently, even in rural Alaska we would still require 2011 and later model year nonroad diesel engines and equipment to be fueled with 15 ppm diesel fuel. The rationale supporting this proposal follows.

a. How Was Alaska Treated Under the Highway Diesel Standards?

Unlike the rest of the nation, Alaska is currently exempt from the 500 ppm sulfur standard for highway diesel fuel and the dye provisions for diesel fuel not subject to this standard. Since the beginning of the 500 ppm highway diesel fuel program, we have granted Alaska exemptions from both the sulfur standard and dye provisions because of its unique geographical, meteorological, air quality, and economic factors.[251]

On December 12, 1995, Alaska submitted a petition for a permanent exemption for all areas of the state served by the Federal Aid Highway System, that is, those areas previously covered only by a temporary exemption. While considering that petition, we started work on a nationwide rule to consider more stringent highway diesel fuel requirements for sulfur content. In the subsequent January 18, 2001 highway diesel sulfur rule (66 FR 5002) the highway engine emission standards were applied fully in Alaska. Based on factors unique to Alaska, we provided the State with: 1) an extension of the exemption from the 500 ppm sulfur highway diesel fuel standard until the effective date of the new 15 ppm sulfur standard for highway diesel fuel in 2006, 2) an opportunity to request an alternative implementation plan for the 15 ppm sulfur diesel fuel program, and 3) a permanent exemption from the diesel fuel dye provisions.

In response to these provisions in our January 18, 2001 highway rule, Alaska informed us that areas served by the Federal Aid Highway System, i.e., communities on the connected road system or served by the Alaska State ferry system, would follow the nationwide requirements. Diesel fuel produced for use in areas of Alaska served by the Federal Aid Highway System will therefore be required to meet the same requirements for highway diesel fuel as diesel fuel

[251] Copies of information regarding Alaska's petition for exemption, subsequent requests by Alaska, public comments received, and actions by EPA are available in public docket A–96–26.

produced for the rest of the nation. For the rural parts of the State, areas not served by the Federal Aid Highway System, Alaska informed us that it would submit by mid-2003 the details for an alternative implementation approach.[252]. EPA will consider their alternative implementation approach when it is received, and if appropriate will initiate rulemaking to finalize its adoption.

b. What Nonroad Standards Do We Propose for Urban Areas of Alaska?

Since Alaska is currently exempt from the 500 ppm sulfur standard for highway diesel fuel, we also considered exempting Alaska from the 500 ppm step of the proposed NRLM standards. However, despite the exemption, officials from the State of Alaska have informed us that 500 ppm highway diesel fuel is nevertheless being marketed in many parts of Alaska. Market forces have brought the prices for 500 ppm diesel fuel down such that it is now becoming competitive with higher sulfur, uncontrolled diesel fuel. Assuming this trend continues, requiring that NRLM diesel fuel be produced to 500 ppm beginning June 1, 2007 would not appear to be unduly burdensome and for this reason, we propose that this standard apply.

At the same time, our expectation is that compliance with the highway program described above may result in the transition of all of the highway diesel fuel distribution system to 15 ppm beginning in 2006. It could prove very challenging for the distribution system in some of the areas to segregate a 500 ppm grade of NRLM from a 15 ppm grade of highway and an uncontrolled grade for other purposes. We believe economics would determine whether the distribution system would handle the new grade of fuel or substitute 15 ppm sulfur highway diesel fuel for NRLM applications. Thus, in the 2007 to 2010 time frame, the NRLM market in some urban areas might be supplied with 500 ppm sulfur diesel, and in other areas might be supplied with 15 ppm sulfur diesel.

Regardless of what takes place prior to 2010, we anticipate that 15 ppm highway diesel fuel will be made available in Alaska by this time frame. The 2007 and later model year highway fleet will be growing, demanding more and more supply of 15 ppm diesel fuel. Adding nonroad volume to this would not appear to create any undue burden. Thus, we also propose that the 15 ppm standard for nonroad diesel fuel would apply in areas of Alaska served by the FAHS, along with the rest of the Nation beginning June 1, 2010. We seek comment on whether the 500 ppm NRLM diesel standard should apply to these areas of Alaska beginning June 1, 2007 and whether the 15 ppm nonroad standard should apply beginning June 1, 2010.

During the development of the original 500 ppm highway diesel fuel standards in the early 1990's refiners and distributors in Alaska expressed concern that if Alaska were required to dye its non-highway diesel fuel red along with the rest of the country, residual dye in tanks or other equipment would be enough to contaminate and disqualify Jet-A kerosene used as aviation fuel. Since much of the diesel fuel in Alaska is number 1 and indistinguishable from Jet A kerosene, not only would tanks and transfer equipment have to be cleaned, but separate tankage would be

[252] Letter and attached document to Jeffrey Holmstead of EPA from Michele Brown of the Alaska Department of Environmental Conservation, dated April 1, 2002. The communities on the connected road system or served by the Alaska State ferry system are listed in the attached document.

needed. Consequently, we granted Alaska temporary exemptions from the dye requirement and in the January 18, 2001 highway diesel rule granted them a permanent exemption. The proposed marker for heating oil in the 2007-10 time period and for locomotive and marine diesel fuel in the 2010-14 time period could present similar concerns in Alaska's distribution system. Consequently, we seek comment on whether to extend the current exemption from the red dye requirement to the proposed marker requirement. If we were to, we then also seek comment on what mechanism could be used in Alaska to ensure that 500 ppm diesel fuel was used in NRLM equipment from 2007-10 and 15 ppm in nonroad equipment after 2010. One possible approach would be to preclude refineries and importers from using credits to comply with the sulfur standards and prohibit end-users in Alaska from using anything but 500 ppm in NRLM equipment from 2007-10 and 15 ppm in nonroad equipment after 2010.

c. What Do We Propose for Rural Areas of Alaska?

Rural Alaska represents a rather unique situation. In the rural areas, the state estimates that the heating oil represent approximately 95% of all distillate consumption (about 50% for heating and 45% for electricity generation). Highway vehicles account for about 1 percent, and marine engines about 4 percent.[253] Consequently, nonroad and locomotive engines and equipment consume a negligible amount of diesel fuel in the rural areas. The fuel storage infrastructure in the villages generally consists of a limited number of small community storage tanks. The fuel must last during the entire winter season when fuel deliveries may not be possible. There is currently only one distillate fuel that is delivered and stored for all distillate purposes in the villages, including home heating, power generation, vehicles, marine engines and possibly some nonroad engines and equipment. Modifications to permit the segregation of small amounts of low sulfur or ultra low-sulfur distillate fuel for highway and/or NRLM use or switching to low sulfur or ultra low-sulfur fuel for all purposes would be an economic hardship for the villages.

Furthermore, as discussed above, for areas not served by the Federal Aid Highway System, the State of Alaska is considering an alternative implementation plan for the 15 ppm and 500 ppm highway standards. One option under consideration by the State would be to not apply these standards in these areas. Rather, the 15 ppm fuel would be provided based on demand to 2007 and later model year vehicles that must be operated on 15 ppm fuel as they enter the fleet. Since the vehicle turnover rate in rural villages is typically very low, and many of the replacement vehicles are pre-owned vehicles themselves, some villages may not obtain their first 2007 or later model year diesel highway vehicle until long after 2010. If such a highway plan would be finalized and EPA subsequently incorporated it into the regulations, the proposed NRLM low-sulfur diesel fuel program, without similar provisions, would require 500 ppm diesel fuel solely for the NRLM market in rural areas beginning June 1, 2007 and 15 ppm sulfur solely for the nonroad market beginning June 1, 2010. Since the demand for new nonroad engines and equipment with aftertreatment (model year 2011 and later) is expected to be nonexistent or very low in the early years in rural Alaska, we believe the best approach is to propose no sulfur or other content requirements for areas of Alaska not served by the FAHS. EPA can revisit this when it receives and takes action on Alaska's highway implementation plan. This will allow for

[253] Email from the Alaska Department of Environmental Conservation, dated July 2, 2002

coordination between the highway and NRLM fuel requirements. As proposed, this would allow rural Alaska to limit the volume of 15 ppm sulfur diesel fuel to that which is sufficient to meet the demand from the small number of new nonroad diesel engines and equipment that would be certified to the Tier 4 nonroad standards proposed today beginning with the 2011 model year.

Our goal in proposing this approach is to allow rural Alaska to transition to the low sulfur fuel program in a manner that minimizes costs while still ensuring that the model year 2011 and later nonroad engines and equipment with aftertreatment receive the 15 ppm diesel fuel they need. Similar to the flexibility being considered under the highway program, the flexibility offered by this proposal would likely result in a delay of some sulfate emission reduction benefits in the rural areas of Alaska. The sulfate emissions of NRLM engines and equipment in Alaska would remain at current levels for as long as high-sulfur diesel fuel is used.

2. American Samoa, Guam, and the Commonwealth of Northern Mariana Islands

a. What Provisions Apply in American Samoa, Guam, and the Commonwealth of Northern Mariana Islands?

We are proposing to exclude American Samoa, Guam and the Commonwealth of the Northern Mariana Islands from the proposed NRLM diesel fuel sulfur standard of 500 ppm sulfur in 2007 and 15 ppm sulfur nonroad standard in 2010, as well as the cetane index and aromatics requirements. We also propose to exclude these territories from the Tier 4 nonroad vehicle, engine and equipment emissions standards, and other requirements associated with those emission standards. The territories will continue to have access to new nonroad diesel engines and equipment using pre-Tier 4 technologies, at least as long as manufacturers choose to market those technologies. We will not allow the emissions control technology in the territories to backslide from those available in 2010. If, in the future, manufacturers choose to market only nonroad diesel engines and equipment with Tier 4 emission control technologies, we believe the market will determine if and when the territories will make the investment needed to obtain and distribute the diesel fuel necessary to support these technologies.

We are also proposing to require that all nonroad diesel engines and equipment for these territories be certified and labeled to the applicable requirements - either to the 2010 model year standards and associated requirements under this proposed exclusion, or to the 2011 and later standards and associated requirements applicable for the model year of production under the nationwide requirements of this proposal - and warranted, as otherwise required under the Clean Air Act and EPA regulations. Special recall and warranty considerations due to the use of excluded high sulfur fuel would be the same as those for Alaska during its exemption and transition periods for highway diesel fuel and for these territories for highway diesel fuel (see 66 FR 5086, 5088, January 18, 2001).

To protect against this exclusion being used to circumvent the emission requirements applicable to the rest of the United States, we are restricting the importation of nonroad engines and equipment from these territories into the rest of the United States. After the 2010 model year, nonroad diesel engines and equipment certified under this exclusion to meet the 2010 model year emission standards for sale in American Samoa, Guam and the Commonwealth of the Northern Mariana Islands will not be permitted entry into the rest of the United States.

b. Why Are We Treating These Territories Uniquely?

Like Alaska, these territories are currently exempt from the 500 ppm sulfur standard for highway diesel fuel. Unlike Alaska and the rest of the nation, they are also exempt from the new highway diesel fuel standard effective in 2006 and the new highway vehicle and engine emission standards effective beginning in 2007 (see 66 FR 5088, January 18, 2001).

Section 325 of the CAA provides that upon request of Guam, American Samoa, the Virgin Islands, or the Commonwealth of the Northern Mariana Islands, we may exempt any person or source, or class of persons or sources, in that territory from any requirement of the CAA, with some specific exceptions. The requested exemption could be granted if we determine that compliance with such requirement is not feasible or is unreasonable due to unique geographical, meteorological, or economic factors of the territory, or other local factors as we consider significant. Prior to the effective date of the current highway diesel sulfur standard of 500 ppm, the territories of American Samoa, Guam and the Commonwealth of Northern Mariana Islands petitioned us for an exemption under section 325 of the CAA from the sulfur requirement under section 211(i) of the CAA and associated regulations at 40 CFR 80.29. We subsequently granted the petitions[254]. We recently determined that the 2007 heavy-duty emission standards and 2006 diesel fuel sulfur standard of our January 18, 2001 highway rule (66 FR 5088) would not apply to these territories.

Compliance with this proposal would result in major economic burden. All three of these territories lack internal petroleum supplies and refining capabilities and rely on long distance imports. Given their remote location from Hawaii and the U.S. mainland, most petroleum products are imported from East rim nations, particularly Singapore. Although Australia, the Philippines, and certain other Asian countries have or will soon require low sulfur diesel fuel, their sulfur limit is 500 ppm, not the new 15 ppm sulfur limit established for highway diesel fuel by the January 18, 2001 highway rule or this proposal for nonroad diesel fuel beginning in 2010 for the United States. Compliance with new 15 ppm sulfur requirements for highway diesel fuel beginning in 2006 and the proposed 15 ppm sulfur requirements for nonroad diesel fuel beginning in 2010 (or the proposed 500 ppm sulfur requirements for NRLM diesel fuel beginning 2007) would require construction of separate storage and handling facilities for a unique grade of diesel fuel for highway and nonroad purposes, or use of 15 ppm diesel fuel for all purposes to avoid segregation. Either of these alternatives would require importation of 500 and 15 ppm sulfur diesel fuel from Hawaii or the U.S. mainland, and would significantly add to the already high cost of diesel fuel in these territories, which rely heavily on United States support for their economies. At the same time, it is not clear that the environmental benefits in these areas would warrant this

[254] See 57 FR 32010, July 20, 1992 for American Samoa; 57 FR 32010, July 30, 1992 for Guam; and 59 FR 26129, May 19, 1994 for CNMI.

cost. Therefore, we are not proposing to apply the fuel and engine standards to these territories, but seek comment on this.

E. How Are State Diesel Fuel Programs Affected by the Sulfur Diesel Program?

Section 211(c)(4)(A) of the CAA prohibits states and political subdivisions of states from prescribing or attempting to enforce, for purposes of motor vehicle emission control, "any control or prohibition respecting any characteristic or component of a fuel or fuel additive in a motor vehicle or motor vehicle engine," if EPA has prescribed "a control or prohibition applicable to such characteristic or component of the fuel or fuel additive" under section 211(c)(1). This prohibition applies to all states except California, as explained in section 211(c)(4)(B). This express preemption provision in section 211(c)(4)(A) applies only to controls or prohibitions respecting any characteristics or components of fuels or fuel additives for motor vehicles or motor vehicle engines, that is, highway vehicles. It does not apply to controls or prohibitions respecting any characteristics or components of fuels or fuel additives for nonroad engines or nonroad vehicles.[255]

Section 211(c)(4)(A) specifically mentions only controls respecting characteristics or components of fuel or fuel additives in a "motor vehicle or motor vehicle engine," adopted "for purposes of motor vehicle emissions control," and the definitions of motor vehicle and nonroad engines and vehicles in CAA section 216 are mutually exclusive. This is in contrast to section 211(a) and (b), which specifically mention application to fuels or fuel additives used in nonroad engines or nonroad vehicles, and with section 211(c)(1) which refers to fuel used in motor vehicles or engines or nonroad engines or vehicles.

Thus, this proposal would not preempt state controls or prohibitions respecting characteristics or components of fuel or fuel additives used in nonroad engines or nonroad vehicles under the provisions of section 211(c)(4)(A). At the same time, a state control that regulates both highway fuel and nonroad fuel is preempted to the extent the state control respects a characteristic or component of highway fuel regulated by EPA under section 211(c)(1).

A court could consider whether a state control for fuels or fuel additives used in nonroad engines or nonroad vehicles is implicitly preempted under the Supremacy Clause of the U.S. Constitution. Courts have determined that a state law is preempted by federal law where the state requirement actually conflicts with federal law by preventing compliance with the federal requirement, or by standing as an obstacle to accomplishment of Congressional objectives. A court could thus consider whether a given state standard for sulfur in nonroad, locomotive or

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[255] See 66 Fed. Reg. 36543 (July 12, 2001) (Notice proposing approval of Houston SIP revisions). See also letter from Carl Edlund, Director, Multimedia Planning and Permitting Division, U.S. Environmental Protection Agency, Region VI, to Jeffrey Saitas, Executive Director, Texas Natural Resources Conservation Commission, dated September 25, 2000, providing comments on proposed revisions to the Texas State Implementation Plan for the control of ozone, specifically the Post 99 Rate of Progress Plan and Attainment Demonstration for the Houston/Galveston area. This letter noted that preemption under section 211(c)(4) did not apply to controls on nonroad diesel fuel.

marine diesel fuel is preempted if it places such significant cost and investment burdens on refiners that refiners cannot meet both state and federal requirements in time, or if the state control would otherwise meet the criteria for conflict preemption.

F. Technological Feasibility of the 500 and 15 ppm sulfur Diesel Fuel Program

This section describes the nonroad, locomotive and marine diesel fuel market and how these fuels differ from current highway diesel fuel, whose sulfur content is already controlled to no more than 500 ppm sulfur. This section then summarizes our assessment of the feasibility of refining and distributing NRLM diesel fuel with a sulfur content of no more than 500 ppm and, for nonroad fuel only, of 15 ppm. Based on this evaluation, we believe it is technologically feasible for refiners and distributors to meet both sulfur standards in the lead time provided. We are only summarizing our analysis here and we refer the reader to the Draft RIA for more details.

1. What is the Nonroad, Locomotive and Marine Diesel Fuel Market Today

Nonroad, locomotive and marine diesel fuel comprise part of what is generally called the distillate fuel market. Other fuels in this market are highway diesel fuel and heating oil, which is used in furnaces and boilers as well as in stationary diesel engines to generate power. Nonroad diesel fuel comprises about 15% of all number 2 distillate fuel, while locomotive and marine diesel fuel comprise about 9% of all number 2 distillate fuel (see Draft RIA).

ASTM defines three number 2 distillate fuels: 1) low sulfur No. 2-D (which includes the 500 ppm sulfur cap for fuel used in highway diesel vehicles), 2) high sulfur No. 2-D, and 3) No. 2 fuel oil (commonly referred to as heating oil).[256] Low sulfur No. 2-D fuel must contain no more than 500 ppm sulfur, have a minimum cetane number of 40, and have a minimum cetane index limit of 40 (or a maximum aromatic content of 35 volume percent). This fuel meets EPA's requirements for current highway diesel vehicle fuel. Both high sulfur No. 2-D and No. 2 fuel oil must contain no more than 5000 ppm sulfur.[257] The ASTM standards for high sulfur No. 2-D fuel also include a minimum cetane number specification of 40. Practically, since most No. 2 fuel oil meets the minimum cetane number specification, pipelines which ship fuel fungibly need only carry one high sulfur number 2 distillate fuel which meets both sets of specifications. Nonroad, locomotive and marine engines can be and are fueled with both low and high sulfur No. 2-D fuels.

During winter months in the northern U.S., No. 1 distillate, such as kerosene, is sometimes added to No. 2 distillate fuel to prevent gelling. Any No. 1 distillate added to No. 2 NRLM diesel fuel would become NRLM diesel fuel.

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[256] "Standard Specification for Diesel Fuel Oils," ASTM D 975-98b and "Standard Specification for Fuel Oils," ASTM D 396-98.

[257] Some states, particularly those in the Northeast, limit the sulfur content of No. 2 fuel oil to 2000-3000 ppm.

Highway diesel fuel, comprises about 57% of all number 2 distillate fuel. Eighty percent of highway diesel fuel will be capped at 15 ppm sulfur starting in 2006. However, because of limitations in the fuel distribution system and other factors, about one-third of non-highway, No. 2 distillate currently meets the 500 ppm highway diesel fuel cap. Thus, about 69 percent of number 2 distillate pool currently meets the 500 ppm sulfur cap, not just the 57 percent used in highway vehicles. The result is that about one-third of the 24% of the distillate market comprised by NRLM diesel fuel currently meets a 500 ppm specification and is also expected to meet the future highway diesel fuel requirements even without this proposed rule. Thus, while this proposed rule would apply to all NRLM diesel fuel, the rule should only materially affect about two-thirds of all NRLM diesel fuel, or 16% of today's distillate market. EPA is not considering any national sulfur standards applicable to home heating fuel or power generation fuel at this time.

2. How Do Nonroad, Locomotive and Marine Diesel Fuel Differ from Highway Diesel Fuel?

Refiners blend together a variety of distillate blendstocks to produce both highway and non-highway diesel fuels. These distillate blendstocks always include straight run material contained in crude oil, plus they often include light cycle oil from a fluidized catalytic cracker, light coker gas oil from a coker and hydrocrackate from a hydrocracker. The actual mix of these blendstocks in highway and non-highway diesel fuel at refineries producing both fuels can differ. However, in general, significant quantities of all of these blendstocks find their way into both low sulfur and high sulfur diesel fuel today. A survey of distillate fuel quality conducted by API and NPRA in 1996 indicated the following feedstock composition for low sulfur diesel fuel and high sulfur diesel fuel and heating oil.

TABLE IV-5 – COMPOSITION OF LOW SULFUR DIESEL FUEL AND HIGH SULFUR DIESEL FUEL AND HEATING OIL: 1996 U.S. NON-CALIFORNIA AVERAGE OF SURVEYED REFINERS (VOLUME PERCENT) [a]

Feedstocks	Low Sulfur No.2 Diesel Fuel	High Sulfur No.2 Diesel Fuel and Heating Oil
Hydrotreated		
Straight Run Material	52	18
Light Cycle Oil	20	11
Light Coker Gas Oil	8	5
Hydrocrackate	4	9
Non-Hydrotreated		
Straight Run Material	12	45
Light Cycle Oil	3	11
Light Coker Gas Oil	1	1

Notes:
[a] We plan to update these compositions to reflect greater use of heavier crude oils in future analyses.

The primary difference between low and high sulfur number 2 distillate fuels today is the fact that a greater volume percentage of low sulfur fuel feedstocks have been hydrotreated to meet the 500 ppm sulfur cap applicable to highway diesel fuel. As shown in the table above, high sulfur distillate fuels may contain significant amounts of hydrotreated material, but the final sulfur level of the blend is usually well above 500 ppm and currently averages 3400 ppm (see Draft RIA). Hydrotreating today typically involves combining diesel fuel with hydrogen and a catalyst under pressures of 400-1200 pounds per square inch and temperatures of roughly 600 degrees Fahrenheit. In general, the existence of the 500 ppm sulfur cap gives refiners an incentive to use low sulfur blendstocks, such as hydrocrackate and straight run, in their low sulfur diesel fuel. However, some high sulfur blendstocks, such as light cycle oil and light gas coker oil, require hydrotreating to remove other undesirable compounds, such as olefins and metals. Once hydrotreated, they are suitable for use in low sulfur diesel fuel. Also, some light cycle oils and light gas coker oils contain so much sulfur and olefins and have such a low cetane number that they are unsuitable for direct blending into even high sulfur diesel fuel, since most high sulfur diesel fuel meets the ASTM sulfur cap of 5000 ppm and cetane number minimum of 40.[258] Where

[258] Non-highway diesel fuel often meets sulfur standards of 2000-3000 ppm in some states, particularly those in the Northeast. These states have limited the sulfur content of home heating oil to these levels. To ease fuel distribution, refiners and distributors sell the same fuel into the home heating fuel and non-highway diesel fuel

material is hydrotreated in order to blend into a high sulfur fuel, it is often easier to hydrotreat the material further to meet a 500 ppm cap and blend straight run material directly into the high sulfur diesel pool. Thus, there is no bright line separating the blendstocks used to produce low and high sulfur diesel fuel today.

3. What Technology Would Refiners Use to Meet the Proposed 500 ppm Sulfur Cap?

Refiners currently hydrotreat some or all of their distillate blendstocks to meet the 500 ppm sulfur cap applicable to highway diesel fuel. Refiners would be able to meet the proposed 500 ppm sulfur cap for NRLM diesel fuel using this same technology. As will be discussed further in the next section, several alternative desulfurization technologies are being developed. However, these alternative technologies promise the greatest cost savings at very low sulfur levels, such as 15 ppm. Also, their ongoing development makes it unlikely that they would be selected by most refiners for production as early as 2007. Finally, the use of conventional hydrotreating technology to meet a 500 ppm standard can readily be combined later with these alternative technologies to meet the subsequent 15 ppm standard in 2010. Thus, we expect that the vast majority of refiners would use conventional hydrotreating to meet the 500 ppm standard in 2007 applicable to NRLM diesel fuel.

Refiners would also likely need to install or modify several existing ancillary units related to sulfur removal (e.g., hydrogen production and purification, sulfur recovery, amine scrubbing and sour water scrubbing facilities). All of these units currently exist at the vast majority of refineries, but may have to be expanded or enlarged.

4. Has Technology to Meet a 500 ppm Cap Been Commercially Demonstrated?

Conventional diesel desulfurization technologies have been available and in use for many years. U.S. refiners have nearly ten years of experience with this technology in producing diesel fuel with less than 500 ppm sulfur for highway use. Thus, the technology to produce 500 ppm NRLM diesel fuel has clearly been demonstrated and optimized over the last decade.

5. Availability of Leadtime to Meet the 2007 500 ppm Sulfur Cap

About 105 refineries in the U.S. currently produce high sulfur distillate fuel. Under the fuel-related provisions of this proposal, we project that roughly 42 of these refineries would likely need to produce 500 ppm NRLM diesel fuel to satisfy the demand for this fuel. The remaining 63 or so refineries would continue to produce high sulfur distillate fuel, either as heating oil or as high sulfur NRLM diesel fuel.

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markets.

If we promulgate this proposal one year from today, this would provide refiners and importers with approximately 38 months before they would have to begin complying with the 500 ppm cap for NRLM diesel fuel on June 1, 2007. Our leadtime analysis, which is presented in the draft RIA, projects that 27-39 months are typically needed to design and construct a diesel fuel hydrotreater.[259] Thus, the leadtime available for the 500 ppm cap in mid-2007 should be sufficient.

Easing the task is the fact that we project that essentially all refiners would use conventional hydrotreating to comply with the 500 ppm NRLM diesel fuel cap. This technology has been used extensively for more than 10 years and its capabilities to process a wide range of diesel fuel blendstocks are well understood. Thus, the time necessary to optimize this technology for a specific refiner's situation should be relatively short.

While conventional hydrotreating would likely be used to meet the 500 ppm cap in 2007, most refiners would have to plan to be able process this fuel further to meet the 15 ppm nonroad diesel fuel cap in 2010. Even those refiners planning on producing 500 ppm locomotive and marine diesel fuel starting in 2010 would likely have to plan for the potential that this fuel could be controlled to 15 ppm sulfur at some time in the future. Thus, the conventional hydrotreater built in 2007 would have to be able to be compatible with the technology eventually chosen to produce 15 ppm fuel in 2010 or later. This could affect the hydrotreater's design pressure, physical location and layout and peripherals, such as hydrogen supply and utilities. However, we project that 34 out of the 42 refineries which we project would produce this fuel also produce highway diesel fuel. Thus, over 80 percent of the refiners likely to produce 500 ppm NRLM fuel in 2007 are already well into their planning for meeting the 15 ppm highway diesel fuel standard, effective June 1, 2006. It is likely that these refiners have already chemically characterized their high sulfur diesel fuel blendstocks, as well as their highway diesel fuel, for potential desulfurization. They will also have already assessed the various technologies for producing 15 ppm diesel fuel and have a good idea of what technology they might use to meet the 15 ppm nonroad diesel fuel cap starting in 2010. Those refiners which only produce high sulfur distillate fuel today would still be able to take advantage of the significant experience that technology vendors have obtained in helping refiners of highway diesel fuel plan for producing 15 ppm diesel fuel in 2006.

Also, of the 34 refineries producing highway diesel fuel today, we project that three will likely build a new hydrotreater to produce 15 ppm highway diesel fuel in 2006. This would allow them to produce 500 ppm NRLM diesel fuel using their existing highway diesel fuel hydrotreater. Another 10 of these 34 refineries produce relatively small volumes of high sulfur distillate compared to highway diesel fuel today. Thus, we project that they should be able to produce 500 ppm NRLM fuel from their high sulfur distillate with minor modification to their existing hydrotreater.

Refiners may also need some time to assess what diesel fuel and heating oil markets they plan on participating in starting 2010. While heating oil may not be widely distributed in PADDs

[259] "Highway Diesel Progress Review," USEPA, EPA420-R-02-016, June 2002.

2, 3 and 4, refiners in PADDs 1 and 3 would still be able to produce heating oil for the Northeast fuel market. Likewise, heating oil may still be distributed in the Pacific Northwest. Under this proposal, locomotive and marine diesel fuel would remain at 500 ppm for some time. Thus, many refiners would require some time to decide what market to participate in after 2010. This strategic planning should be able to coincide with refiners' evaluation of 15 ppm technologies and not add to the overall lead time required.

In all, we project that the task of producing 500 ppm NRLM fuel in 2007 would be less difficult than the task refiners faced with the implementation of the 500 ppm highway diesel fuel cap in 1993. Refiners had just over three years of leadtime for the highway diesel fuel cap, as is the case here and this proved sufficient.

6. What Technology Would Refiners Use to Meet the Proposed 15 ppm Sulfur Cap for Nonroad Diesel Fuel?

We project that refiners would be able to use a variety of desulfurization technologies to meet the proposed 15 ppm sulfur cap for nonroad fuel. One approach would be to use an extension of conventional hydrotreating technology. We expect that refiners would utilize hydrotreating to meet the proposed 500 ppm standard. We expect that refiners would design this hydrotreater to facilitate the addition of a second reactor or hydrotreating stage to further desulfurize their distillate blendstocks from 500 ppm to 15 ppm. Refiners might also shift to the use of an improved catalyst even in the first reactor (i.e., that producing roughly 500 ppm sulfur product), as well as add equipment to further purify the hydrogen used.

This is the same technology which EPA projected would be used by most refiners to meet the 15 ppm sulfur cap for highway diesel fuel. EPA just recently reviewed the progress being made by refining technology vendors and refiners in meeting the 2006 highway diesel sulfur cap.[260] All evidence available confirms EPA's projection that conventional hydrotreating will be capable of producing diesel fuel containing less than 10 ppm sulfur. Refiners producing only high sulfur distillate today should have an added advantage in meeting a 15 ppm sulfur cap for nonroad fuel over that for highway fuel. They would be able to design their hydrotreater from the ground up, while most refiners producing 15 ppm diesel fuel for highway use will be trying to utilize their existing 500 ppm hydrotreaters, which may not be designed to be revamped to produce 15 ppm fuel in the most efficient manner.

Based on our review of the limited catalyst performance data in the published literature and the one set of confidential data submitted, we believe that the projections of the more optimistic vendors are the most accurate for the 2010 timeframe given this additional leadtime. For example, the confidential commercial data indicated that five ppm sulfur levels could be achieved with two-stage hydrotreating at moderate hydrogen pressure despite the presence of a significant amount of light cycle oil (LCO). The key factor was the inclusion of a hydrogenation

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[260] "Highway Diesel Progress Review," EPA, June 2002, EPA420-R-02-016.

catalyst in the second stage, which saturated many of the poly-nuclear, aromatic rings in the diesel fuel, allowing the removal of sulfur from the most sterically hindered compounds. In addition, refiners that are able to defer production of 15 ppm highway diesel fuel through the purchase of credits, as well as refiners producing 15 ppm nonroad in 2010, would have the added benefit of being able to observe the operation of those hydrotreating units starting up in 2006. This should allow these refiners to be able to select from the best technologies which are employed in the highway program.

In addition, a number of alternative technologies are presently being developed which could produce 15 ppm fuel at lower cost. ConocoPhillips, for example, has developed a version of their S-Zorb technology for diesel fuel desulfurization. This technology utilizes a catalytic adsorbent to remove the sulfur atom from hydrocarbon molecules. It then sends the sulfur-laden catalyst to a separate reactor, where the sulfur is removed and the catalyst is restored. Unipure is developing a process which selectively oxidizes the sulfur contained in diesel fuel. This process have the advantage that the sulfur containing compounds which are most difficult to desulfurize via hydrotreating are quite easily desulfurized via oxidation. Finally, Linde has developed a method which greatly improves the concentration of hydrogen on hydrotreating catalysts. This process promises to greatly reduce the reactor volume necessary to produce 15 ppm diesel fuel.

These three new technologies are at various stages of development. This is discussed in more detail in the next section. Due to the projected ability of these technologies to reduce the cost of meeting a 15 ppm sulfur cap and the leadtime available between now and 2010, we project that 80% of the new volume of 15 ppm nonroad diesel fuel would be produced using advanced technologies.

7. Has Technology to Meet a 15 ppm Cap Been Commercially Demonstrated?

EPA just completed a review of refiners' progress in preparing to produce 15 ppm highway diesel fuel.[261] The information we obtained during that review confirm the projections we made in the HD 2007 program – refiners are technically capable of producing 15 ppm sulfur diesel fuel using extensions of conventional technology and, in fact, they are moving forward with their plans to comply with the program. Thus, we believe there are no technological hurdles to producing 15 ppm diesel fuel.

The European Union has also determined that diesel fuel can be desulfurized to meet a sulfur cap in the range of 10-15 ppm. Europe has established a 10 ppm sulfur cap on highway diesel fuel, effective in 2009, with plans underway for a 10 ppm sulfur cap for nonroad diesel fuel soon thereafter. As with our standards, Europe's 10 ppm cap applies throughout the distribution system. However, fuel tends to be transported much shorter distances in Europe. Therefore, we believe that both the 10 and 15 ppm sulfur caps will require refiners to meet the same 7-8 ppm sulfur target at the refinery gate. Given this, the European standard will require the same technology as that required in the U.S. Most European diesel fuel must meet a higher cetane

[261] *Ibid*.

number specification than U.S. diesel fuel, which causes it to be predominantly comprised of straight run material. This material is easier to desulfurize to sub-15 ppm levels using conventional hydtrotreating technology. In some European countries, nonroad diesel fuel is the same as heating oil and contains significant amounts of cracked material. Thus, on average, it should be easier for European refiners to meet a 10 ppm sulfur cap with their highway diesel fuel than in the U.S. As the 10 ppm cap is extended to nonroad diesel fuel, the stringency of the European standard will be much closer to that of a 15 ppm cap here in the U.S.

We have met with a number of diesel fuel refiners to learn about their plans to produce 15 ppm highway diesel fuel by the June 2006 program compliance date. Since the 15 ppm diesel fuel sulfur standard was established based on the use of extensions of conventional diesel desulfurization technologies, diesel fuel refineries are well positioned to make firm plans for implementation by 2006. Our review has found that this is exactly what refiners are doing. We are very encouraged by the actions some refiners have already taken in terms of announcing specific plans for low sulfur diesel fuel production. It may still be early in the process, but virtually all refiners are already in the stage of planning their approach for compliance. Thus, the refining industry is where we anticipated it would be at this point in time. Moreover, some refining companies are ahead of schedule and will be capable of producing significant quantities of 15 ppm sulfur diesel fuel as early as next year. Thus, we expect that the capability of conventional hydrotreating to produce 15 ppm diesel fuel in refinery-scale quantities will be demonstrated in the U.S. by the end of 2003.

Phillips Petroleum is currently in the process of designing and constructing a commercial sized S-Zorb unit to produce sub-15 ppm diesel fuel at their Sweeney, Texas refinery. This plant is scheduled to begin commercial operation in 2004. This would provide refiners with roughly 3 years of operating data before they would have to decide which technology to use to meet the 15 ppm nonroad sulfur cap in 2010. This should be enough operating experience for most refiners to have sufficient confidence in this advanced process to include it in their options for 2010 compliance. Based on information received from Phillips Petroleum, we estimate that this technology could reduce the cost of meeting the 15 ppm cap for many refiners by 25 percent.

Linde has also developed a new approach for improving the contact between hydrogen, diesel fuel and conventional desulfurization catalysts. Linde projects that their Iso-Therming process could reduce the hydrotreater volume required to achieve sub-15 ppm sulfur levels by roughly a factor of 2. Linde has already built a commercial-sized demonstration unit at a refinery in New Mexico and has been operating the equipment since September 2002. Thus, refiners would have 4-5 years of operating data available on this process before they would have to decide which technology to use to meet the 15 ppm nonroad sulfur cap in 2010. This should be ample operating experience for essentially all refiners to include this process in their options for 2010. Based on information received from Linde, we estimate that this technology could reduce the cost of meeting the 15 ppm cap for many refiners by 40 percent.

Finally, Unipure Corporation is developing a desulfurization process which oxidizes the sulfur atom in diesel fuel molecules, facilitating its removal. This process operates at low temperatures and ambient pressure, so it avoids the need for costly, thick walled, pressure vessels and compressors. It also consumes no hydrogen. Thus, it could be particularly advantageous for refiners who lack an inexpensive supply of hydrogen (e.g., isolated or smaller refineries who cannot construct a world scale hydrogen plant based on inexpensive natural gas). However, the oxidant is very powerful, so specialized, oxidation resistant materials are needed. Unipure has demonstrated its process at the pilot plant level, but has yet to build a commercial sized demonstration unit. However, time still remains for this to be done before refiners need to make final decisions for their 2010 compliance plans. Thus, while more uncertain than the other two advanced processes, the Unipure oxidation process could be selected by a number of refiners to meet the 2010 15 ppm cap. Based on inputs from Unipure, we estimate that their process could reduce the cost of meeting the 15 ppm cap for roughly one-fourth of all refineries by 25-35 percent.

The savings associated with each technology varies with the size, location and complexity of the refinery. However, on average the Linde process appears to have the potential reduce the cost of desulfurizing 500 ppm diesel fuel to 15 ppm by 35-40 percent. The savings associated with the Phillips and Unipure processes appear to be more refinery specific. For about 25 refineries, the Phillips process appears to have the potential to reduce these desulfurization costs by 20-40 percent. The primary advantage of the Unipure process is its lower capital costs. For about 30 refineries, the Unipure process appears to have the potential to reduce the capital investment related to produce 15 ppm fuel from 500 ppm diesel fuel by an average of 40 percent.

8. Availability of Leadtime to Meet the 2010 15 ppm Sulfur Cap

If we promulgate this proposal one year from today, this would provide refiners and importers with more than six years before they would have to begin complying with the 15 ppm cap for nonroad diesel fuel on June 1, 2010. Our leadtime analysis, which is presented in the draft RIA, projects that 30-39 months are typically needed to design and construct a diesel fuel hydrotreater.[262] Thus, refiners would have about 3 years before they would have to begin detailed design and construction. This would allow them time to observe the performance of the hydrotreaters being used to produce 15 ppm highway diesel fuel for at least one year. While not a full catalyst cycle, any unusual degradation in catalyst performance over time should be apparent within the first year. Thus, we project that the 2010 start date would allow refiners to be quite certain that the designs they select in mid-2007 will perform adequately in 2010.

In addition, we expect that most of the advanced technologies will be demonstrated on a commercial scale by the end of 2004. Thus, refiners would have at least two and a half years to observe the performance of these technologies before having to select a technology to meet the 2010 15 ppm cap. This should be more than adequate to fully access the costs and capabilities of these technologies for all but the most cautious refiners.

[262] "Highway Diesel Progress Review," USEPA, EPA420-R-02-016, June 2002.

9. Feasibility of Distributing Nonroad, Locomotive and Marine Diesel Fuels that Meet the Proposed Sulfur Standards

There are two considerations with respect to the feasibility of distributing non-highway diesel fuels meeting the proposed sulfur standards. The first pertains to whether sulfur contamination can be adequately managed throughout the distribution system so that fuel delivered to the end-user does not exceed the specified maximum sulfur concentration. The second pertains to the physical limitations of the system to accommodate any additional segregation of product grades.

a. Limiting Sulfur Contamination

With respect to limiting sulfur contamination during distribution, the physical hardware and distribution practices for non-highway diesel fuel do not differ significantly from those for highway diesel fuel. Therefore, we do not anticipate any new issues with respect to limiting sulfur contamination during the distribution of non-highway fuel that would not have already been accounted for in distributing highway diesel fuel. Highway diesel fuel has been required to meet a 500 ppm sulfur standard since 1993. Thus, we expect that limiting contamination during the distribution of 500 ppm non-highway diesel engine fuel can be readily accomplished by industry.

In the highway diesel rule, EPA acknowledged that meeting a 15 ppm sulfur specification would pose a substantial new challenge to the distribution system. Refiners, pipelines and terminals would have to pay careful attention to and eliminate any potential sources of contamination in the system (e.g., tank bottoms, deal legs in pipelines, leaking valves, interface cuts, etc.) In addition, bulk plant operators and delivery truck operators would have to carefully observe recommended industry practices to limit contamination, including practices as simple as cleaning out transfer hoses, proper sequencing of fuel deliveries, and parking on a level surface. Due to the need to prepare for compliance with the highway diesel program, we anticipate that issues related to limiting sulfur contamination during the distribution of 15 ppm nonroad diesel fuel will be resolved well in advance of the proposed 2010 implementation date for nonroad fuel. We are not aware of any additional issues that might be raised unique to nonroad fuel. If anything we anticipate limiting contamination will become easier as batch sizes are allowed to increase and potential sources of contamination decrease. We request comment on whether there are unique considerations regarding the transition to a 15 ppm standard for nonroad diesel fuel and what actions we should take beyond those that are already underway in preparation for the 15 ppm highway diesel program.

b. Potential Need for Additional Product Segregation

As discussed in sub-section B, we have designed the proposed program to minimize the need for additional product segregation and the associated feasibility and cost issues associated with it. This proposal would allow for the fungible distribution of 500 ppm highway and 500 ppm NRLM diesel fuel in 2007, and 15 ppm highway and 15 ppm nonroad diesel fuel in 2010, up until the point where NRLM or nonroad fuel must be dyed for IRS excise tax purposes. Heating oil would be required to be segregated as a separate pool beginning in 2007 through the use of a new marker, and locomotive and marine fuel by use of the same marker beginning in 2010. With this program design, we believe we have eliminated any potential feasibility issues associated with the need for product segregation. This is not to say that steps will not have to be taken. We have identified only a single instance where it seems likely that the adoption of this proposal would result in entities in the distribution system choosing to add new tankage due to new product segregation. Bulk plants in areas of the country where heating oil is expected to remain in the market will have to decide whether to add tankage to distribute both heating oil and 500 ppm NRLM fuel. In all other cases we anticipate segments of the distribution system will choose to avoid any fuel segregation costs by limiting the range of sulfur grades they choose to carry, just as they do today. Regardless, however, the costs and impacts of these choices are small. We request comment on this assessment. A more detailed explanation of this assessment can be found in Chapter 5.6 of the draft RIA.

G. What Are the Potential Impacts of the 15 ppm sulfur Diesel Program on Lubricity and Other Fuel Properties?

1. What Is Lubricity and Why Might it Be a Concern?

Engine manufacturers and owner/operators depend on diesel fuel lubricity properties to lubricate and protect moving parts within fuel pumps and injection systems for reliable performance. Unit injector systems and in-line pumps, commonly used in diesel engines, are actuated by cams lubricated with crankcase oil, and have minimal sensitivity to fuel lubricity. However, rotary and distributor type pumps, commonly used in light and medium-duty diesel engines, are completely fuel lubricated, resulting in high sensitivity to fuel lubricity. The types of fuel pumps and injection systems used in nonroad diesel engines are the same as those used in highway diesel vehicles. Consequently, nonroad and highway diesel engines share the same need for adequate fuel lubricity to maintain fuel pump and injection system durability.

Diesel fuel lubricity concerns were first highlighted for private and commercial vehicles during the initial implementation of the federal 500 ppm sulfur highway diesel program and the state of California's diesel program. The Department of Defense (DoD) also has a longstanding concern regarding the lubricity of distillate fuels used in its equipment as evidenced by the implementation of its own fuel lubricity improver performance specification in 1989.[263] The diesel fuel requirements in the state of California differed from the federal requirements by substantially restricting the content of diesel fuel requires more severe hydrotreating than reducing

[263] DoD Performance Specification, Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble, , MIL-PRF-25017F, 10 November 1997, Superseding MIL-I-25017E, 15 June 1989.

the sulfur content to meet a 500 ppm standard.[264] Consequently, concerns regarding diesel fuel lubricity have primarily been associated with California diesel fuel and some California refiners treat their diesel fuel with a lubricity additive as needed. Outside of California, hydrotreating to meet the current 500 ppm sulfur specification does not typically result in a substantial reduction of lubricity. Diesel fuels outside of California seldom require the use of a lubricity additive. Therefore, we anticipate only a marginal increase in the use of lubricity additives in NRLM diesel fuel meeting the proposed 500 ppm sulfur standard for 2007.[265] This proposal would require diesel fuel used in nonroad engines to meet a 15 ppm sulfur standard in 2010. Based on the following discussion, we believe that the increase in the use of lubricity additives in 15 ppm nonroad diesel fuel would be the same as that estimated for 15 ppm highway diesel fuel.

The state of California currently requires the same standards for diesel fuel used in nonroad equipment as in highway equipment. Outside of California, highway diesel fuel is often used in nonroad equipment when logistical constraints or market influences in the fuel distribution system limit the availability of high sulfur fuel. Thus, for nearly a decade nonroad equipment has been using federal 500 ppm sulfur diesel fuel and California diesel fuel, some of which may have been treated with lubricity additives. During this time, there has been no indication that the level of diesel lubricity needed for fuel used in nonroad engines differs substantially from the level needed for fuel used in highway diesel engines.

Blending small amounts of lubricity-enhancing additives increases the lubricity of poor-lubricity fuels to acceptable levels. These additives are available in today's market, are effective, and are in widespread use around the world. Among the available additives, biodiesel has been suggested as one potential means for increasing the lubricity of conventional diesel fuel. Indications are that low concentrations of biodiesel would be sufficient to raise the lubricity to acceptable levels.

Considerable research remains to be performed to better understand which fuel components are most responsible for lubricity. Consequently, it is unclear whether and to what degree the proposed sulfur standards for non-highway diesel engine fuel will impact fuel lubricity. Nevertheless, there is evidence that the typical process used to remove sulfur from diesel fuel -- hydrotreating – can impact lubricity depending on the severity of the treatment process and characteristics of the crude. We expect that hydrotreating will be the predominant process used to reduce the sulfur content of non-highway diesel engine fuel to meet the 500 ppm sulfur standard during the first step of the proposed program. The highway diesel program projected that hydrotreating would be the process most frequently used to meet the 15 ppm sulfur standard for highway diesel fuel. The 2010 implementation date for the proposed 15 ppm standard for

[264] Chevron Products Diesel Fuel Technical Review provides a discussion of the impacts on fuel lubricity of current diesel fuel compositional requirements in California versus the rest of the nation. http://www.chevron.com/prodserv/fuels/bulletin/diesel/l2%5F7%5F2%5Frf.htm

[265] The cost from the increased use of lubricity additives in 500 ppm NRLM diesel fuel in 2007 and in 15 ppm nonroad diesel fuel in 2010 is discussed in Section V of today’s preamble.

nonroad diesel fuel would allow the use of new technologies to remove sulfur from fuel.[266] These new technologies have less of a tendency to affect other fuel properties than does hydrotreating.

Based on our comparison of the blendstocks and processes used to manufacture non-highway diesel fuels, we believe that the potential decrease in the lubricity of these fuels from hydrotreating that might result from the proposed sulfur standards should be approximately the same as that experienced in desulfurizing highway diesel fuel.[267] To provide a conservative, high cost estimate, we assumed that the potential impact on fuel lubricity from the use of the new desulfurization processes would be the same as that experienced when hydrotreating diesel fuel to meet a 15 ppm sulfur standard. We request comment on the potential impact of these new desulfurization technologies on lubricity (as well as other fuel properties) that might help us to improve our estimate of the potential impacts of this proposal on fuel properties other than sulfur. Given that the requirements for fuel lubricity in highway and non-highway engines are the same, and the potential decrease in lubricity from desulfurization of non-highway diesel engine would be no greater than that experienced in desulfurizing highway diesel fuel, we estimate that the potential need for lubricity additives in non-highway diesel engine fuel under this proposal would be the same as that for highway diesel fuel meeting the same sulfur standard.

2. A Voluntary Approach on Lubricity

In the United States, there is no government or industry standard for diesel fuel lubricity. Therefore, specifications for lubricity are determined by the market. Since the beginning of the 500 ppm sulfur highway diesel program in 1993, refiners, engine manufacturers, engine component manufacturers, and the military have been working with the American Society for Testing and Materials (ASTM) to develop protocols and standards for diesel fuel lubricity in its D-975 specifications for diesel fuel. ASTM is working towards a single lubricity specification that would be applicable to all diesel fuel used in any type of engine. Although ASTM has not yet adopted specific protocols and standards, refiners that supply the US market have been treating diesel fuel with lubricity additives on a batch to batch basis, when poor lubricity fuel is expected. Other examples include the U.S. military, Sweden, and Canada. The U.S. military has found that the traditional corrosion inhibitor additives used in its fuels have been highly effective in reducing fuel system component wear. Since 1991, the use of lubricity additives in Sweden's 10 ppm sulfur Class I fuel and 50 ppm sulfur Class II fuel has resulted in acceptable equipment durability.[268] Since 1997, Canada has required that its 500 ppm sulfur diesel fuel not meeting a minimum lubricity be treated with lubricity additives.

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[266] See Section IV.F for a discussion of which desulfurization processes we expect will be used to meet the 15 ppm standard for nonroad diesel fuel.

[267] See Chapter 5 of the RIA for a discussion of the potential impacts on fuel lubricity of this proposal.

[268] Letter from L. Erlandsson, MTC AB, to Michael P. Walsh, dated October 16, 2000. EPA air docket A-99-06, docket item IV-G-42.

The potential need for lubricity additives in diesel fuel meeting a 15 ppm sulfur specification was evaluated during the development of EPA's highway diesel rule. In response to the proposed highway diesel rule, all comments submitted regarding lubricity either stated or implied that the proposed sulfur standard of 15 ppm would likely cause the refined fuel to have lubricity characteristics that would be inadequate to protect fuel injection equipment, and that mitigation measures such as lubricity additives would be necessary. However, the commenters suggested varied approaches for addressing lubricity. For example, some suggested that we need to establish a lubricity requirement by regulation while others suggested that the current voluntary, market based system would be adequate. The Department of Defense recommended that we encourage the industry (ASTM) to adopt lubricity protocols and standards before the 2006 implementation date of the 15 ppm sulfur standard for highway diesel fuel.

The final highway diesel rule did not establish a lubricity standard for highway diesel fuel. We believe the issues related to the need for diesel lubricity in fuel used in non-highway diesel engines are substantially the same as those related to the need for diesel lubricity for highway engines. Consequently, we expect the same industry-based voluntary approach to ensuring adequate lubricity in non-highway diesel fuels that we recognized for highway diesel fuel. We believe the best approach is to allow the market to address the lubricity issue in the most economical manner, while avoiding an additional regulatory scheme. A voluntary approach should provide adequate customer protection from engine failures due to low lubricity, while providing the maximum flexibility for the industry. This approach would be a continuation of current industry practices for diesel fuel produced to meet the current federal and California 500 ppm sulfur highway diesel fuel specifications, and benefits from the considerable experience gained since 1993. It would also include any new specifications and test procedures that we expect would be adopted by the American Society for Testing and Materials (ASTM) regarding lubricity of NRLM diesel fuel quality.

Regardless, this is an issue that will be resolved to meet the demands of the highway diesel market, and whatever resolution is reached for highway diesel fuel could be applied to non-highway diesel engine fuel with sufficient advance notice. We are continuing to participate in the ASTM Diesel Fuel Lubricity Task Force[269] and will assist their efforts to finalize a lubricity standard in whatever means possible. We are hopeful that ASTM can reach a consensus early this summer at the next meeting of the ASTM's Lubricity Task Force. We request comment on what actio
ns EPA should take to ensure adequate lubricity of non-highway diesel engine fuel beyond those already underway for highway diesel fuel.

3. What Other Impact Would Today's Actions Have on the Performance of Diesel and Other Fuels?

[269] ASTM sub committee D02.E0.

We do not expect that the proposed fuel program would have any negative impacts on the performance of diesel engines in the existing fleet which would use the fuels regulated today. In the early 1990's, California lowered the maximum allowable level of sulfur content of highway and nonroad diesel fuel to 500 ppm, and at the same time California significantly lowered the aromatic content of diesel fuel. California required a cap on total aromatics of 10 percent by volume, while the in-use average at the time was on the order of 35 percent. The lowering of the total aromatic content resulted in some problems with leaks from the fuel pump O-ring seals in some diesel engines due to a change specifically in the polynuclear aromatics content (PNA). In the process of meeting California's 10 percent total aromatic content requirement, the end result typically lowered PNA's from approximately 10 - 15 percent by volume to near-zero. In the early 1990's, some diesel engine manufacturers used a certain material (Nitrile) for O-rings in diesel fuel pumps. The Nitrile seals were found to be susceptible to leakage with the use of diesel fuel with very low PNA content. Normally, the PNA in the fuel penetrated the Nitrile material and cause it to swell, thereby providing a seal with the throttle shaft. When very low PNA fuel is used after conventional fuel has been used, the PNA already in the swelled O-ring would leach out into the very low PNA fuel. Subsequently, the Nitrile O-ring would shrink and pull away, thus causing leaks, or the stress on the O-ring during the leaching process would cause it to crack and leak. Not all 500 ppm sulfur fuels caused this problem, because the amount and type of aromatics varied, and the in-use seal problems were focused in California due to the 10 percent aromatic requirements and the resulting very low PNA content. This was not a wide-spread issue for the rest of the U.S. where highway diesel fuel also had a 500ppm sulfur cap because the federal requirements did not include a lower aromatic cap. While the process of lowering sulfur levels to 500ppm does lower PNA, it does not achieve the near-zero levels seen in California. Since the 1990's, diesel engine manufacturers have switched to alternative materials (such as Viton), which do not experience leakage. We believe that no issues with leaking fuel pump O-rings would occur with the changes in diesel fuel sulfur levels contained in this proposal (both the 500 ppm requirement in 2008 and the 15 ppm requirement in 2010) because while we do believe PNA content will be reduced, we are not predicting it will achieve the near-zero level experienced in California.

We expect that this proposal would have no negative impacts on other fuels, such as jet fuel or heating oil. We do expect that the sulfur levels of heating oil would decrease because of this proposal. Beginning in mid-2007, we expect that controlling NRLM diesel fuel to 500 ppm would lead many pipelines to discontinue carrying high sulfur heating oil as a separate grade. In areas served by these pipelines, heating oil users would likely switch to 500 ppm diesel fuel. This would reduce emissions of sulfur dioxide and sulfate PM from furnaces and boilers fueled with heating oil. The primary exception to this would likely be the Northeast and some areas of the Pacific Northwest, where a distinct higher sulfur heating oil would still be distributed as a separate fuel. Also, we expect that a small volume of high sulfur distillate fuel would be created during distribution from the mixing of low sulfur diesel fuels and higher sulfur fuels, such as jet fuel in the pipeline interface. Such high sulfur distillate would likely be sold by the terminal as high sulfur heating oil or reprocessed by transmix processors.

H. Refinery Air Permitting

Prior to making diesel desulfurization changes, some refineries may be required to obtain a preconstruction permit, under the New Source Review (NSR) program, from the applicable state/local air pollution control agency.[270] We believe that the proposed program provides sufficient lead time for refiners to obtain any necessary NSR permits well in advance of the compliance date.

Given that today's diesel sulfur program would provide roughly three years of lead time before the 500 ppm standard would take effect, we believe refiners would have time to obtain any necessary preconstruction permits. Nevertheless, we believe it is reasonable to continue our efforts under the Tier 2 and highway diesel fuel programs, to help states in facilitating the issuance of permits under the NRLM diesel sulfur program. For example, the guidance on Best Available Control Technology (BACT) and Lowest Achievable Emission Rate (LAER) control technology that was developed for the gasoline sulfur program should have application for diesel desulfurization (highway and NRLM) projects as well. Similarly, we believe the concept of EPA permit teams for gasoline sulfur projects could readily be extended to permits related to diesel projects as well. These teams, as needed, would track the overall progress of permit issuance and would be available to assist state/local permitting authorities, refineries and the public upon request to resolve site-specific permitting questions. In addition, these teams would be available, as necessary, to assist in resolving case specific issues to ensure timely issuance of permits. Finally, to facilitate the processing of permits, we encourage refineries to begin discussions with permitting agencies and to submit permit applications as early as possible.

V. Program Costs and Benefits

In this section, we present the projected cost impacts and cost effectiveness of the proposed nonroad Tier 4 emission standards and low-sulfur fuel requirement. We also present a benefit-cost analysis and an economic impact analysis. The benefit-cost analysis explores the net yearly economic benefits to society of the reduction in mobile source emissions likely to be achieved by this rulemaking. The economic impact analysis explores how the costs of the rule will likely be shared across the manufacturers and users of the engines, equipment and fuel that would be affected by the standards.

The results detailed below show that this rule would be highly beneficial to society, with net present value benefits through 2030 of $550 billion, compared to a net present value of social cost of only about $16.5 billion (net present values in the year 2004). The impact of these costs

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[270] Hydrotreating diesel fuel involves the use of process heaters, which have the potential to emit pollutants associated with combustion, such as NOx, PM, CO and SO2. In addition, reconfiguring refinery processes to add desulfurization equipment could increase fugitive VOC emissions. The emissions increases associated with diesel desulfurization would vary widely from refinery to refinery, depending on many source-specific factors, such as crude oil supply, refinery configuration, type of desulfurization technology, amount of diesel fuel produced, and type of fuel used to fire the process heaters.

on society should be minimal, with the prices of goods and services produced using equipment and fuel affected by the proposal being expected to increase about 0.02 percent.

Further information on these and other aspects of the economic impacts of our proposal are summarized in the following sections and are presented in more detail in the Draft RIA for this rulemaking. We invite the reader to comment on all aspects of these analyses, including our methodology and the assumptions and data that underlie our analysis.

A. Refining and Distribution Costs

As described above, the fuel-related requirements associated with this proposed rule would be implemented in two steps. Nonroad, locomotive and marine diesel fuel would be subject to a 500 ppm sulfur cap beginning June 1, 2007, while nonroad diesel fuel would be subject to a 15 ppm sulfur cap beginning June 1, 2010. Meeting these standards would generally require refiners adding hydrotreating equipment and possibly new or expanded hydrogen and sulfur plants in their refineries for desulfurizing their nonroad diesel fuel and dispensing of the removed sulfur. Using information provided by vendors of desulfurization equipment and through discussions with distributors of nonroad diesel fuel, we estimated the desulfurization and associated distribution and additive cost for complying with this two step desulfurization program. Except for the costs presented at the end of this section, the costs below reflect a fully phased in fuels program without the proposed small refiner exemption. Costs are in 2002 dollars. We request comment on the cost estimates presented below and the methodologies used to develop them. You can refer to the Draft RIA for details.

The cost to provide nonroad, locomotive and marine diesel fuel under the proposed fuel program is summarized in Table V-A-1 below. The costs shown (and all of the costs described in the rest of this section) only apply to the roughly 65 percent of current nonroad, locomotive and marine diesel fuel that contains more than 500 ppm sulfur (hereafter referred to as the affected volume). We estimate that the other 35 percent of this fuel is actually fuel certified to the highway diesel fuel standards and project that this will continue. Thus, the proposed fuel program would not affect this fuel and no additional costs would be incurred by its refiners or distributors. The costs and benefits of desulfurizing this highway fuel which spills over into the non-highway markets was already included in EPA's 2007 highway diesel fuel rule.

Table V-A-1 Increased Cost of Providing Nonroad, Locomotive and Marine Diesel Fuel

	cents per gallon of affected fuel			Affected Fuel Volume (million gallons/year)[a]
	Refining	Lubricity and Distribution	Total	
Step One - 500 ppm NRLM diesel fuel	2.2	0.3	2.5	9,504
Step Two - 15 ppm Nonroad diesel fuel	4.4	0.4	4.8	7,803

Step Two - 500 ppm Locomotive and Marine diesel fuel	2.2	0.2 [b]	2.4	4,093

Notes:
[a] 2008 for Step One (without consideration of small refiner provisions), 2015 for Step Two
[b] 0.4 cent per gallon from mid-2010 to mid-2014 due to need for marker

The majority of the fuel-related cost of the proposal is refining-related. These costs include required capital investments amortized at 7 percent per annum before taxes. The derivation of these costs is discussed in more detail below and in the Draft RIA. We request comment on the estimated cost of meeting the 15 ppm and 500 ppm sulfur caps.

We also project that the increased cost of refining and distributing 15 ppm and 500 ppm fuel would be substantially offset by reductions in maintenance costs. These savings would apply to all diesel engines in the field, not just new engines. Refer to Section V. B for a more complete discussion on the projected maintenance savings associated with lower sulfur fuels.

1. Refining Costs

Our process for estimating the refining costs associated with the proposed fuel program consisted of four steps. One, we estimated the volume of 500 and 15 ppm nonroad, locomotive and marine diesel fuel which had to be produced in each PADD[271] in each phase of the program. This step utilized diesel fuel and heating oil use estimates from the Energy Information Administration's (EIA) Fuel Oil and Kerosene Survey for 2000, shipments of diesel fuel between PADDs, projected loss of 15 and 500 ppm volume due to contamination during distribution and small refiner provisions. This nonroad diesel fuel consumption in 2000 is lower than that inherent in the emission estimates described above, which are based directly on the results of EPA's NONROAD emission model. We are investigating ways to make the two estimates more consistent.

Growth in distillate fuel use off this year 2000 base was estimated using projections from EIA's Annual Energy Outlook, with one exception. This exception was that the growth in nonroad diesel fuel use was taken from EPA's NONROAD emission model (roughly three percent per year), as opposed to EIA's projected growth of roughly one percent per year. The higher growth rate is consistent with that inherent in the emission estimates described above.

Refinery production of low and high sulfur distillate fuel in the year 2000 was based on actual reports provided to EIA by all U.S. refiners and importers. Refinery production of low and high sulfur distillate fuel was assumed to grow at the same rate as consumption of the two types of fuel, respectively. These rates were roughly three percent and one and a half percent for low and high sulfur distillate fuel production, respectively. The specific volumes of highway, nonroad, locomotive, and marine diesel fuel by calendar year are presented in Chapter 7 of the Draft RIA.

[271] Petroleum Administrative for Defense Districts.

Two, we estimated the cost for each refinery to desulfurize its high sulfur fuel to 500 and 15 ppm. This was based on their historical production volume of high sulfur diesel fuel and estimates of the composition of this fuel (straight run, light cycle oil, etc.).[272] We also considered whether these refineries would be modifying or building hydrotreating capacity in order to meet the 15 ppm highway cap.

Three, we estimated which refineries would find it difficult to market all of their current high sulfur diesel fuel as heating oil, due to their location relative to major pipelines and the size of the heating oil market in their area. Those not located in major heating oil markets and not connected to pipelines serving these areas were projected to have to meet the 500 ppm cap in 2007.

Four, we determined the additional refineries which would produce 500 ppm and 15 ppm fuel to satisfy demand during each phase of the fuel program. Refineries projected to have the lowest compliance costs in each PADD were projected to produce the lower sulfur fuels until demand was met. PADD 3 refineries were allowed to ship low sulfur fuel to the Northeast, but no other inter-PADD transfers were assumed. Imports of 500 ppm highway diesel fuel were assumed to increase at the rate of highway diesel fuel consumption and be converted to 15 ppm diesel fuel, 80 percent in 2006 and 100 percent in 2010. Imports of high sulfur distillate fuel were assumed to increase at the rate of high sulfur distillate fuel consumption, but were assumed to remain entirely high sulfur heating oil even after today's NRLM fuel proposal. In other words, all 15 ppm and 500 ppm NRLM fuel produced under this proposal was assumed to be produced by domestic refineries. This assumption increased the projected costs of the proposal described above more than would have been the case had we assumed that domestic production and imports of high sulfur distillate fuel would each keep their respective shares of the NRLM diesel fuel and heating oil markets in response to this proposal. The relative costs of producing 15 ppm nonroad diesel fuel by domestic and overseas refiners is discussed further in Section V.A.6. below.

With the onset of a 2007 500 ppm sulfur cap for nonroad, locomotive and marine diesel fuel, we project that the market for high sulfur diesel fuel and heating oil would become so small that high sulfur fuel would no longer be shipped through common carrier pipelines in most areas. The prime exception to this would be the Northeast, where the heating oil market is very large. Thus, refiners located in the Northeast and those along the major pipelines serving the Northeast, namely the Colonial and Plantation pipelines, could continue to produce high sulfur heating oil. Other refineries would shift the production of high sulfur diesel fuel and heating oil to the 500 ppm NRLM market. The second exception would be refiners granted special provisions due to the small size of their business (i.e., SBREFA refiners) or economic hardship, as discussed in

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[272] The composition of nonroad diesel fuel in each PADD was based on a survey conducted by API and NPRA in 1996. Crude oils processed by domestic refiners have been becoming heavier over time, necessitating greater use of coking and hydrocracking to convert the heavy material into lighter, saleable products. Thus, the contributions of coker and hydrocracked distillate to the overall distillate pool are rising. Coker distillate is somewhat more difficult to desulfurize than average distillate, but hydrocracked distillate is much easier to desulfurize. Overall, this trend could increase projected desulfurization costs slightly. We plan to update these compositions to reflect trends in crude oil quality and refinery configuration in our analysis for the final rule to the extent that more recent data allow.

Section IV above. The high sulfur distillate production levels of these refineries is small enough that they can sell into more local nonroad, locomotive and marine markets or the heating oil market without using pipelines and so they could continue to produce high sulfur distillate.

Based on refinery distillate production data from the Energy Information Administration (EIA), there are 122 refineries currently producing highway diesel fuel and 105 refineries producing high sulfur diesel fuel or heating oil. Using the methodology described above, absent this proposal, we project that roughly 114 refineries will invest in additional desulfurization equipment to produce 15 ppm highway diesel fuel; 74 refineries in 2006 and 40 in 2010.[273] These 114 refineries include 109 of the 122 refineries which currently produce highway diesel fuel, plus 5 refineries currently which currently only produce high sulfur distillate fuel today. Again absent the proposed NRLM diesel fuel program, we project that roughly 13 refineries currently producing highway diesel fuel will shift to producing high sulfur distillate fuel. This would leave a total of 113 refineries still producing high sulfur distillate after full implementation of the 2007 highway diesel fuel program.

The number of these 113 domestic refineries expected to produce either 500 ppm of 15 ppm NRLM diesel fuel in response to this proposal is summarized in Table V-A-2.

TABLE V-A-2 REFINERIES PROJECTED TO PRODUCE NRLM DIESEL FUEL UNDER THIS PROPOSAL

Year of Program	500 ppm Diesel Fuel		15 ppm Diesel Fuel	
	All Refineries	Small Refineries	All Refineries	Small Refineries
2007-2010	42	0	0	0
2010-2014	37	19	25	0
2014+	25	12	37	7

As shown in this table, we project that 42 of the 113 refineries currently producing some high sulfur distillate would desulfurize their high sulfur diesel fuel in response to the proposed 500 ppm standard in 2007. The remainder would continue producing either high sulfur NRLM diesel fuel under the proposed small refiner provisions, or high sulfur heating oil. As explained in Section IV.F, we project that these refiners would use conventional hydrotreating technology to meet this standard. Of these 42 refineries, we project that 32 would build new hydrotreaters to meet the 500 ppm sulfur cap. We project that three of the remaining ten refineries would be able to meet the 500 ppm cap with their existing hydrotreater which is currently being used to produce highway diesel fuel. These three refineries are projected to build a new hydrotreater to produce 15

[273] These (and the subsequent) estimates of the number of refineries investing in new equipment to produce diesel fuels of various sulfur levels should be understood as rough estimates which assist us in projecting costs and other impacts related to this proposal. They are most reasonable when evaluating the total number of refineries investing in a particular year or region. We are not indicating that we believe that we can predict which specific refineries would invest in desulfurization equipment in response to this proposal.

ppm highway diesel fuel in 2006, so their existing highway fuel hydrotreater could process their current high sulfur diesel fuel. The remaining seven refineries currently produce relatively small amounts of high sulfur diesel fuel compared to their highway diesel fuel production. We project that these refiners would be able to economically revamp their existing highway hydrotreater to process their non-highway diesel fuel.

We project that the capital cost involved to meet the 2007 500 ppm sulfur cap would be $600 million, or $9.7 million per refinery building a new hydrotreater. The bulk of this capital would be invested in 2007 ($500 million), with the remainder being invested in 2010.[274] Operating costs would be about $3 million per year for the average refinery. We request comment on the number of refiners who would need to build new equipment to meet the 500 ppm sulfur cap, the capital cost for this new equipment and the cost of operating this equipment.

Starting in mid-2010, we project that 25 refineries would add or revamp equipment to meet the 15 ppm cap on nonroad diesel fuel, while 20 refineries (nearly all of them small refiners) would add or revamp equipment to produce 500 ppm nonroad or locomotive and marine diesel fuel. Finally, an additional 12 refineries (again nearly all of them small refiners) would begin producing 15 ppm nonroad diesel fuel in 2014.

We project that 80 percent of the 15 ppm nonroad diesel fuel volume would be desulfurized by advanced technologies, while the remaining 20 percent would be desulfurized by conventional hydrotreaters. Since the bulk of the hydrotreating capacity being used to meet the 2007 500 ppm standard for NRLM diesel fuel would have just been built in 2007 or 2010, we expect that it would have been designed to facilitate further processing to 15 ppm sulfur and the added 15 ppm facilities would be revamps. However, those refiners who used their existing highway diesel fuel hydrotreaters to meet the proposed 500 ppm cap in 2007 would likely have to construct new equipment in 2010 or 2014 to meet the 15 ppm cap on nonroad diesel fuel, since these hydrotreaters could not be revamped in 2006 to produce 15 ppm highway diesel fuel. When the proposed NRLM diesel fuel program would be fully implemented in 2014, roughly 51 refineries are still projected to produce high sulfur heating oil and thus, would not face any refining costs related to this proposal.

Our projection that 80 percent of refineries would utilize some form of advanced technology to meet the proposed 15 ppm nonroad fuel sulfur cap is based on the fact that this 15 ppm cap would follow the production of 15 ppm highway diesel fuel by four years. Several firms are expending significant research and development resources to bring such advanced technologies to the market for the highway diesel fuel program. We developed cost estimates for two such technologies: Linde Iso-Therming and Phillips S-Zorb. The development of cost estimates for these two advanced technologies, as well as conventional hydrotreating, is described in detail in Chapter 7 of the Draft RIA. We request comment on the potential viability and cost savings associated with advanced desulfurization technologies, particularly in the 2010 timeframe.

[274] Some refineries would be able to delay production of 500 ppm NRLM fuel until 2010 due to the proposed small refiner provisions. Likewise, some refineries would be able to delay production of 15 ppm nonroad diesel fuel until 2014.

The total capital cost of new equipment and revamps related to the proposed 2010 sulfur standard would be $640 million, or $17 million per refinery adding or revamping equipment. Total operating costs would be about $5 million per year for the average refinery. The total refining cost, including the amortized cost of capital, would be 4.4 cents per gallon of new 15 ppm nonroad fuel. This cost is relative to the cost of producing high sulfur fuel today, and includes the cost of meeting the 500 ppm standard beginning in 2007. We request comment on the number of refiners who would need to build new equipment to meet the 15 ppm sulfur cap, the capital cost for this new equipment and the cost of operating this equipment. The average cost of continuing to meet the 500 ppm standard for locomotive and marine fuel would continue at 2.2 cents per gallon.

The above costs reflect national averages for the fully phased in program for each control step. Some refiners would face lower costs while others would face higher costs. Excluding small refiners because they are able to take advantage of the proposed small refiner provisions, the average refining costs by refining region are shown in the table below. Combined costs are shown for PADDs 1 and 3 because of the large volume of diesel fuel which is shipped from PADD 3 to PADD 1.

TABLE V-A-3 -- AVERAGE REFINING COSTS BY REGION (CENTS PER GALLON)

	2007 500 ppm Cap	2010 15 ppm Cap
PADDs 1 and 3	1.4	2.6
PADD 2	2.9	5.7
PADD 4	4.0	8.5
PADD 5	2.6	5.4
Nationwide	2.2	4.4

We request comment on the range of estimated refining costs for the various regions for both the proposed 500 and 15 ppm sulfur caps.

2. Cost of Lubricity Additives

Hydrotreating diesel fuel tends to reduce the natural lubricating quality of diesel fuel, which is necessary for the proper functioning of certain fuel system components. There are a variety of fuel additives which can be used to restore diesel fuel's lubricating quality. These additives are currently used to some extent in highway diesel fuel. We expect that the need for lubricity additives that would result from the proposed 500 ppm sulfur standard for off-highway diesel engine fuel would be similar to that for highway diesel fuel meeting the current 500 ppm sulfur cap standard.[275] Industry experience indicates that the vast majority of highway diesel fuel meeting the current 500 ppm sulfur cap does not need lubricity additives. Therefore, we expect that the great majority of off-highway diesel engine fuel meeting the proposed 500 ppm sulfur standard would also not need lubricity additives. In estimating lubricity additive costs for 500 ppm diesel fuel, we assumed that fuel suppliers would use the same additives at the same concentration as we projected would be used in 15 ppm highway diesel fuel. Based on our analysis of this issue for the 2007 highway diesel fuel program, the cost per gallon of the lubricity additive is about 0.2 cent. This level of use is likely conservative, as the amount of lubricity additive needed increases substantially as diesel fuel is desulfurized to lower levels. We also project that only 5 percent of all 500 ppm NRLM diesel fuel would require the use of a lubricity additive. Thus, we project that the cost of additional lubricity additives for the affected 500 ppm NRLM diesel fuel would be 0.01 cent per gallon. See the Draft RIA for more details on the issue of lubricity additives.

We project that all nonroad diesel fuel meeting a 15 ppm cap would require treatment with lubricity additives. Thus, the projected cost would be 0.2 cent per affected gallon of 15 ppm nonroad diesel fuel.

3. Distribution Costs

The proposed fuel program is projected to impact distribution costs in three ways. One, we project that more diesel fuel would have to be distributed under the proposal than without it. This is due to the fact that some of the desulfurization processes reduce the fuel's volumetric energy density during processing. Total energy is not lost during processing, as the total volume of fuel is increased. However, a greater volume of fuel must be consumed in the engine to produce the same amount of power. We assumed that the current cost of distributing diesel fuel of 10 cents per gallon (see Draft RIA for further details) would stay constant (i.e., a 1 percent increase in the amount of fuel distributed would increase total distribution costs by 1 percent).

We project that desulfurizing diesel fuel to 500 ppm would reduce volumetric energy content by 0.7 percent. This would increase the cost of distributing fuel by 0.07 cent per gallon. We project that desulfurizing diesel fuel to 15 ppm would reduce volumetric energy content by an additional 0.35 percent. This would increase the cost of distributing fuel by an additional 0.04 cent per gallon, or a total cost of 0.11 cent per gallon of affected 15 ppm nonroad diesel fuel.

Two, while this proposal minimizes the segregation of similar fuels, some additional segregation of products in the distribution system would still be required. The proposed allowance that highway and off-highway diesel engine fuel meeting the same sulfur specification can be shipped fungibly until it leaves the terminal obviates the need for additional storage

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[275] Please refer to Section IV in today's preamble for additional discussion regarding our projections of the potential impact on fuel lubricity of this proposed rule.

tankage in this segment of the distribution system.[276] This proposal would also allow 500 ppm NRLM diesel fuel to be mixed with high-sulfur NRLM diesel fuel once the fuels are dyed to meet IRS requirements. This provision would ease the last part of the distribution of high-sulfur NRLM diesel fuel.

However, we expect that the implementation of the proposed 500 ppm standard for NRLM diesel fuel in 2007 would compel some bulk plants in those parts of the country still distributing heating oil as a separate fuel grade to install a second diesel storage tank to handle this 500 ppm nonroad fuel. These bulk plants currently handle only high-sulfur fuel and hence would need a second tank to continue their current practice of selling fuel into the heating oil market in the winter and into the nonroad market in the summer.[277] We believe that some of these bulk plants would convert their existing diesel tank to 500 ppm fuel in order to avoid the expense of installing an additional tank. However, to provide a conservatively high estimate we assumed that 10 percent of the approximately 10,000 bulk plants in the U.S. (1,000) would install a second tank in order to handle both 500 ppm NRLM diesel fuel and heating oil. The cost of an additional storage tank at a bulk plant is estimated at $90,000 and the cost of de-manifolding their delivery truck at $10,000.[278] If all 1,000 bulk plants were to install a new tank, the total one-time capitol cost would be $100,000,000. Amortizing the capital costs over 20 years, results in a estimated cost for tankage at such bulk plants of 0.1 cent per gallon of affected NRLM diesel fuel supplied. Although the impact on the overall cost of the proposed program is small, the cost to those bulk plant operators who need to put in a separate storage tank may represent a substantial investment. Thus, as discussed in Section IV.F., we believe many of these bulk plants could make other arrangements to continue servicing both heating oil and NRLM markets.

Due to the end of the highway program temporary compliance option (TCO) in 2010 and the disappearance of high-sulfur diesel fuel from much of the fuel distribution system due to the implementation of this proposed rule, we expect that storage tanks at many bulk plants which were previously devoted to 500 ppm TCO highway fuel and high-sulfur fuel would become available for dyed 15 ppm nonroad diesel service. Based on this assessment, we do not expect that a significant number of bulk plants would need to install an additional storage tank in order to provide dyed and undyed 15 ppm diesel fuel to their customers beginning in 2010 (the proposed implementation date for the 15 ppm nonroad standard) .[279] There could potentially be some additional costs related to the need for new tankage in some areas not already carrying 500 ppm fuel under the temporary compliance option of the highway diesel program and which continue to carry high sulfur fuel. However, we expect them to minimal relative to the above 0.1 cent per gallon cost. Thus, we estimate that the total cost of additional storage tanks that would result

[276] Including the refinery, pipeline, marine tanker, and barge segments of the distribution system.

[277] See Section IV.E.9. of this proposal and Chapter 5 of the RIA for additional discussion of the potential impacts of the proposed sulfur standards on the distribution system.

[278] This estimated cost includes the addition of a separate delivery system on the tank truck.

[279] See Section IV of today's preamble for additional discussion of our rational for this conclusion.

from the adoption of this proposal would be 0.1 cent per gallon of affected off-highway diesel engine fuel supplied.

Three, the proposed requirement that high sulfur heating oil be marked between 2007 and 2010 and that locomotive and marine diesel fuel be marked from 2010 until 2014 would increase the cost of distributing these fuels slightly. Based on input from marker manufacturers, we estimate that marking these fuels would cost no more than 0.2 cent per gallon and could cost considerably less. There should be no capital cost associated with this requirement, as we are proposing to remove the current requirement that refiners dye all high sulfur distillate at the refinery. The current dyeing equipment should work equally well for the marker. Because heating oil is being marked to prevent its use in NRLM engines, we have spread the cost for this marker over NRLM diesel fuel. Thus, from a regulatory point of view, the heating oil marker would increase the cost of NRLM diesel fuel between 2007 and 2010 by 0.16 cent per gallon. We attribute the cost of marking 500 ppm locomotive and marine diesel fuel directly to this fuel, so the marker cost is simply 0.2 cent per gallon of locomotive and marine diesel fuel between 2010 and 2014.

We do not project any additional downgrade of 15 ppm diesel fuel would result from the proposed fuel program. In our analysis of the 15 ppm highway fuel program, we also projected additional distribution costs due to the need to downgrade more volume of highway diesel fuel to a lower value product. This is a consequence of the large difference between the sulfur content of 15 ppm fuel and other distillate products, like high sulfur diesel fuel, heating oil and jet fuel.[280] We do not project that these costs would increase with this proposed rule. Highway diesel fuel meeting a 15 ppm cap will already be being distributed in all major pipeline and terminal networks. Thus, we expect that 15 ppm nonroad fuel would be added to batches of 15 ppm already being distributed. In this situation, the total interface volume needing to be downgraded would not increase. At the same time, we are not projecting that interface volume would decrease, as high sulfur fuels, such as jet fuel, would still be in the system.

Thus, overall, we estimate that the total additional distribution would be 0.3 cent per gallon of nonroad, locomotive and marine fuel during the first step of the proposed program (from 2007 through 2010). We project that distribution costs would increase to 0.4 cent gallon for 500 ppm locomotive and marine diesel fuel from 2010 to 2014, but decrease to 0.2 cent per gallon thereafter. Finally, we project that distribution costs for 15 ppm nonroad diesel fuel would be 0.2 cent gallon.

4. How EPA's Projected Costs Compare to Other Available Estimates

We used two different methods for evaluating how well our cost estimates reflect the true costs for complying with the two step nonroad fuel program. The first method compared our costs

[280] Off-highway diesel fuel sulfur content is currently unregulated and is approximately 3,400 ppm on average. The maximum allowed sulfur content of heating oil is 5,000 ppm. The maximum allowed sulfur content of kerosene (and jet fuel) is 3,000 ppm.

with the incremental market price of diesel fuel meeting a 15 or 500 ppm standard. The second method compared our cost estimate to that from an engineering analysis analogous to the one we performed.

Beginning with market prices, highway diesel fuel meeting a 500 ppm sulfur cap has been marketed in the U.S. for almost ten years. Over the five year period from 1995 - 1999, its national average price has exceeded that of high sulfur diesel fuel by about 2.4 cent per gallon (see Chapter 7 of the Draft RIA). While fuel prices are a often a function of market forces which might not reflect the cost of producing the fuel, the comparison of the price difference over a fairly long period such as 5 years would tend to reduce the effect of the market on the prices and more closely reflect the cost of complying with the 500 ppm cap standard. Thus, we feel that this is a sound basis for evaluating our cost estimate. This price difference is essentially the same as our estimated cost for refining and distributing 500 ppm non-highway diesel fuel, thus the price difference for producing and distributing 500 ppm highway fuel corroborates our cost analysis.

Some 15 ppm diesel fuel is marketed today. However, it is either being produced in very limited quantities using equipment designed to meet less stringent sulfur standards or with other properties which make it unrepresentative of typical U.S. NRLM diesel fuel. Thus, current market prices are not a good indication of the long term price impact of the proposed 15 ppm cap.

Regarding engineering studies, the Engine Manufactures Association (EMA) commissioned a study by Mathpro to estimate the cost of controlling the sulfur content of highway and nonroad diesel fuel to levels consistent with both 500 ppm and 15 ppm cap standards.[281] Mathpro used a higher rate of return on new capital so we adjusted their per-gallon costs to reflect our own amortization methodology. Also, the Mathpro study was completed in 1999 so we adjusted their costs for inflation to year 2002 dollars. After these two adjustments, Mathpro's cost to desulfurize the high sulfur non-highway pool to 500 ppm is 2.5 cents per gallon, while that for a 15 ppm cap is 5.8 cents per gallon.[282] The 500 ppm cost estimate compares quite favorably with our own estimate of 2.2 cents per gallon cost. One reason for our somewhat lower estimate for complying with the 500 ppm standard is that our refinery-specific analysis has only the lowest cost refineries complying as many more expensive refineries can continue to produce heating oil. It is likely that the refineries which our analysis show would comply are more optimized for desulfurizating diesel fuel than the average refinery used by Mathpro. This reason applies even more for 15 ppm cap standard as fewer, more optimized refineries need to comply to produce nonroad diesel fuel which complies with a 15 ppm sulfur cap standard . Furthermore, we considered the use of advanced desulfurization technologies for complying with the 15 ppm standard, while Mathpro did not. Since the Mathpro study was performed in 1999, cost estimates were not available for either of the two technologies which we included. The adjustment of the Mathpro costs and the comparison with our own cost estimates are discussed in detail in the Draft

[281] Hirshfeld, David, MathPro, Inc., "Refining economics of diesel fuel sulfur standards," performed for the Engine Manufactuers Association, October 5, 1999.

[282] The Mathpro costs cited reflect their case where current diesel fuel hydrotreaters are revamped with a new reactor in series, which is the most consistent with our technology projection.

RIA. We request comment on the degree that the results of the Mathpro study for EMA and the comparison with real-world prices support our own cost estimates.

5. Supply of Nonroad, Locomotive and Marine Diesel Fuel

EPA has developed the proposed fuel program to minimize its impact on the supply of distillate fuel. For example: we have proposed to transition the fuel sulfur level down to 15 ppm in two steps, providing an estimated 6 years of leadtime for the final step; we are proposing to provide flexibility to refiners through the availability of banking and trading provisions; and we have provided relief for small refiners and hardship relief for any qualifying refiner. In order to evaluate the effect of this proposal on supply, EPA evaluated four possible cases: 1) whether the proposed standards could cause refiners to remove certain blendstocks from the fuel pool, 2) whether the proposed standards could require chemical processing which loses fuel in the process, 3) whether the cost of meeting the proposed standards could lead some refiners to leave that market, and 4) whether the cost of meeting the proposed standards could lead some refiners to stop operations altogether (i.e., shut down). In all cases, as discussed below, we have concluded that the answer is no. Therefore, consistent with our findings made during the 2007 highway diesel rule, we do not expect this proposed rule to cause any supply shortages of nonroad, locomotive and marine diesel fuel. The reader is referred to the draft RIA for a more detailed discussion of the potential supply impact of this proposed rule.

Blendstock Shift: There should be no long term reduction in the amount of material derived from crude oil available for blending into diesel fuel or heating oil as a result of this proposal. Technology exists to desulfurize any commercial diesel fuel to less than 10 ppm sulfur. This technology is just now being proven on a commercial scale with a range of no. 2 diesel fuel blendstocks, as a number of refiners are producing 15 ppm fuel for diesel fleets which have been retro-fitted with PM traps or for pipeline testing. Therefore, there is no technical necessity to remove certain blendstocks from the diesel fuel pool. It costs more to process certain blendstocks, such as light cycle oil, than others. Therefore, there may be economic incentives to move certain blendstocks out of the diesel fuel market to reduce compliance costs. However, that is an economic issue, not a technical issue and will be addressed below when we consider whether refiners might choose to exit the NRLM diesel fuel market.

Processing Losses: The impact of the proposed rule on the total output of liquid fuel from refineries would be negligible. Conventional desulfurization processes do not reduce the energy content of the input material. However, the form of the material is affected slightly. With conventional hydrotreating, about 98 percent of the diesel fuel fed to a hydrotreater producing 15 ppm sulfur product leaves as diesel fuel. Of the 2 percent loss, three-fourths, or about 1.5 percent leaves the unit as naphtha (i.e., gasoline feedstock). The remainder is split evenly between liquified petroleum gas (LPG) and refinery fuel gas. Both naphtha and LPG have higher valuable uses as liquid fuels. Naphtha can be used to produce gasoline. Refiners can adjust the relative amounts of gasoline and diesel fuel which they produce, especially to this small degree. This additional naphtha can displace other gasoline blendstocks, which can then be shifted to the diesel fuel pool. LPG, on the other hand, is primarily used in heating, where it competes with heating oil. Thus, additional LPG can be used to displace gasoline and heating oil, which in turn can be shifted to the diesel fuel pool. Thus, there should be little or no direct impact of desulfurization on refinery fuel production. The shift from diesel fuel to fuel gas is very small (0.25 percent) and this fuel gas can be used to reduce consumption of natural gas within the refinery. These figures apply to the full effect of the proposed standards (i.e., the reduction in sulfur content from 3400 ppm to 15 ppm). For the first step of the proposed fuel program and that portion of the diesel fuel pool which would remain at the 500 ppm level indefinitely, the impacts would only be about 40 percent of those described above.

The use of advanced desulfurization technologies would further reduce these impacts. These technologies are projected to be used in the second step of reducing 500 ppm diesel fuel to 15 ppm sulfur. We project that the Linde process would reduce the above losses for the second step by 55 percent, while the Phillips SZorb process would have no loss in diesel fuel production.

Exit the NRLM Diesel Fuel Market: While the cost of meeting the proposed standards might cause some individual refiners to consider reducing their production of NRLM fuel or leave the market entirely, we do not believe that across the entire industry such a shift is possible or likely. As mentioned above, all diesel fuels and heating oil are essentially identical both chemically and physically, except for sulfur level. Thus, if a refiner could shift his high sulfur distillate material from the nonroad, locomotive and marine diesel fuel markets to the heating oil market starting in mid-2007, it would avoid the need to invest in new desulfurization equipment. Likewise, starting in mid-2010, a refiner could focus his 500 ppm diesel fuel in the locomotive and marine diesel fuel markets or shift this material to the heating oil market. The problem would be a potential oversupply of heating oil starting in 2007 and locomotive and marine diesel fuel and heating oil starting in 2010. An oversupply could lead to a substantial drop in market price, significantly increasing the cost of leaving the nonroad, locomotive and marine diesel fuel markets. Or, it may be necessary to export the higher sulfur fuel in order to sell it. This could entail transportation costs and overseas prices no higher than existed in the U.S. before the oversupply (and possibly lower due to these imports now entering these overseas markets).

We addressed this same issue during the development of 2007 highway diesel fuel program. There, the issue was whether refiners would shift some or all of their current highway diesel fuel production to either domestic or overseas markets for high sulfur diesel fuel or heating oil in order to avoid investing to meet the 15 ppm cap for highway diesel fuel. A study by Charles River Associates, *et. al.*, sponsored by API projected that there could be a near-term shortfall in highway diesel fuel supply of as much as 12 percent.[283] However, supported by a study by Muse, Stancil, we concluded that refiners would incur greater economic loss in trying to avoid meeting the 15 ppm highway diesel fuel cap than they would by complying at current production levels even if the market did not allow them to recover their capital investment. A study by Mathpro, Inc. for AAM and EMA also criticized the conclusions of the Charles River study, particularly their assumption that compliance costs alone would drive investment decisions and that there was

[283] "An Assessment of the Potential Impacts of Proposed Environmental Regulations on U.S. Refinery Supply of Diesel Fuel,: Charles River Associates and Baker and O'Brien, for API, August 2000.

essentially a single highway diesel fuel market nationwide.[284] Mathpro demonstrated that smaller refineries located, for example, in the Rocky Mountain region, likely faced higher per gallon compliance costs, but also had been more profitable over the past 15 years than larger refiners in other areas with lower overall costs. This was due to their market niches and the inability for lower cost refiners to ship large volumes of fuel economically to their market.

We believe that the same conclusions apply to the proposed fuel program for six reasons. One, the alternative markets for high sulfur diesel fuel and heating oil would be even more limited after the proposed sulfur caps on nonroad, locomotive and marine diesel fuel than they will be in 2006, as half of the current U.S. market for high sulfur, no. 2 distillate would disappear. We expect that high sulfur heating oil would not even by carried be common carrier pipelines except those serving the Northeast. Therefore, refiners' sale of high sulfur distillate may be limited to markets serviceable by truck. Two, the desulfurization technology to meet a 500 ppm cap has been commercially demonstrated for over a decade. The desulfurization technology to meet a 15 ppm cap will have been commercially demonstrated in mid-2006, a full four years prior to the implementation of the 15 ppm cap on nonroad diesel fuel. Three, the volume of fuel affected by the 15 ppm nonroad diesel fuel standard would be only one-seventh of that affected by the highway diesel fuel program. This dramatically reduces the required capital investment. Four, both Europe and Japan are implementing sulfur caps for highway and nonroad diesel fuel in the range of 10-15 ppm, eliminating these markets as a sink for high sulfur diesel fuel. Five, refineries outside of the U.S. and Europe are operating at a lower percentage of their capacity than U.S. refineries. Thus, U.S. refineries would not be able to obtain attractive prices for high sulfur diesel fuel overseas. Finally, refinery profit margins were much higher during the last part of 2000 and most of 2001 than over the past ten years, indicating a potential long-term improvement in profitability. Margins decreased again during most in 2002, but recovered during the last few months of that year and in early 2003.

Once refiners have made their investments to meet the proposed NRLM diesel fuel standards, or have decided to produce high sulfur heating oil, we expect that the various distillate markets would operate very similar to today's markets. When fully implemented in 2014, there will be three distillate fuels in the market, 15 ppm highway and nonroad diesel fuel, 500 ppm locomotive and marine diesel fuel and high sulfur heating oil. The market for 500 ppm locomotive and marine diesel fuel is much smaller than the other two, particularly considering that it is nationwide and the heating oil market is geographically concentrated. Therefore, the vast majority of refiners are expected to focus on producing either 15 ppm or high sulfur distillate, which is similar to today, where there are two fuels, 500 ppm and high sulfur distillate. In this case, refiners with the capability of producing 15 ppm diesel fuel have the most flexibility, since they can sell their fuel to any of the three markets. Refiners with only 500 ppm desulfurization capability can supply two markets. Those refiners only capable of producing high sulfur distillate would not be able to participate in either the 15 or 500 ppm markets. However, this is not different from today. Generally, we do not expect one market to provide vastly different profit

[284] "Prospects for Adequate Supply of Ultra Low Sulfur Diesel Fuel in the Transition Period (2006-2007), An Analysis of Technical and Economic Driving Forces for Investment in ULSD Capacity in the U.S. Refining Sector," MathPro, Inc., for AAM and EMA, December 7, 2001.

margins than the others, as high profit margins in one market will attract refiners from another via investment in desulfurization equipment.

Refinery Closure: There are a number of reasons why we do not believe that refineries would completely close down under this proposed rule. One reason is that we have included provisions to provide relief for small refiners, as well as any refiner facing unusual financial hardship. Another reason is that nonroad, locomotive and marine diesel fuel is usually the third or fourth most important product produced by the refinery from a financial perspective. A total shutdown would mean losing all the revenue and profit from these other products. Gasoline is usually the most important product, followed by highway diesel fuel and jet fuel. A few refineries do not produce either gasoline or highway diesel fuel, so jet fuel and high sulfur diesel fuel and heating oil are their most important products. The few refiners in this category likely face the biggest financial challenge in meeting the proposed requirements. However, those refiners would also presumably be in the best position to apply for special hardship provisions, presuming that they do not have readily available source of investment capital. The additional time afforded by these provisions should allow the refiner to generate sufficient cash flow to invest in the required desulfurization equipment. Investment here could also provide them the opportunity to expand into more profitable (e.g., highway diesel) markets.

A quantitative evaluation of whether the cost of the proposed fuel program could cause some refineries to cease operations completely would be very difficult, if not impossible to perform. A major factor in any decision to shut down is the refiner's current financial situation. It is very difficult to assess an individual refinery's current financial situation. This includes a refiner's debt, as well as its profitability in producing fuels other than those affected by a particular regulation. It can also include the profitability of other operations and businesses owned by the refiner.

Such an intensive analysis can be done to some degree in the context of an application for special hardship provisions, as discussed above. However, in this case, EPA can request detailed financial documents not normally available. Prior to such application, as is the case now, this financial information is usually confidential. Even when it is published, the data usually apply to more than just the operation of a single refinery.

Another factor is the need for capital investments other than for this proposed rule. EPA can roughly project the capital needed to meet other new fuel quality specifications, such as the Tier 2 or highway diesel sulfur standards. However, we cannot predict investments to meet local environmental and safety regulations, nor other investments needed to compete economically with other refiners.

Finally, any decision to close in the future must be based on some assumption of future fuel prices. Fuel prices are very difficult to project in absolute terms. The response of prices to changes in fuel quality specifications, such as sulfur content, as is discussed in the next section, are also very difficult to predict. Thus, even if we had complete knowledge of a refiner's financial status and its need for future investments, the decision to stay in business or close would still depend on future earnings, which are highly dependent on the prices of all products produced by that refinery.

Some studies in this area point to fuel pricing over the past 15 years or so and conclude that prices will only increase to reflect increased operating costs and will not reflect the cost of capital. In fact, the rate of return on refining assets has been poor over the past 15 years and until recently, there has been a steady decline in the number of refineries operating in the U.S. However, this may have been due to a couple of circumstances specific to that time period. One, refinery capacity utilization was less than 80 percent in 1985. Two, at least regarding gasoline, the oxygen mandate for reformulated gasoline caused an increase in gasoline supply despite low refinery utilization rates. While this led to healthy financial returns for oxygenate production, it did not help refining profit margins.

Today, refinery capacity utilization in the U.S. is generally considered to be at its maximum sustainable rate. There are no regulatory mandates on the horizon which will increase production capacity significantly, even if ethanol use in gasoline increases substantially.[285] Consistent with this, refining margins have been much better over the past two and a half years than during the previous 15 years and the refining industry itself is projecting good returns for the foreseeable future.

6. Fuel Prices

It is well known that it is difficult to predict fuel prices in absolute terms with any accuracy. The price of crude oil dominates the cost of producing gasoline and diesel fuel. Crude oil prices have varied by more than a factor of two in the past year. In addition, unexpectedly warm or cold winters can significantly affect heating oil consumption, which affects the amount of gasoline produced and the amount of distillate material available for diesel fuel production. Economic growth, or its lack, affects fuel demand, particularly for diesel fuel. Finally, both planned and unplanned shutdowns of refineries for maintenance and repairs can significantly affect total fuel production, inventory levels and resulting fuel prices.

Predicting the impact of any individual factor on fuel price is also difficult. The overall volatility in fuel prices limits the ability to determine the effect of a factor which changed at a specific point in time which might have led to the price change, as other factors continue to change over time. Occasionally, a fuel quality change, such as reformulated gasoline or a 500 ppm cap on diesel fuel sulfur content, only affects a portion of the fuel pool. In this case, an indication of the impact on price can be inferred by comparing the prices of the two fuels at the same general location over time. However, this is still only possible after the fact, and cannot be done before the fuel quality change takes place.

[285] Both houses of the U.S. Congress are considering bills which would require the increased use of renewables, like ethanol, in gasoline and diesel fuel. While the amount of renewables could be considerable, it is well below the annual growth in transportation fuel use.

Because of these difficulties, EPA has generally not attempted to project the impact of its rules on fuel prices. However, in response to Executive Order 13211, we are doing so for this proposed rule. To reflect the inherent uncertainty in making such projections, we developed three projections for the potential impact of the proposed fuel program on fuel prices. The range of potential long-term price increases are shown in Table V-A-4. Short-term price impacts are highly volatile, as are short-term swings in absolute fuel prices, and much too dependent on individual refiners' decisions, unexpected shutdowns, etc. to be predicted even with broad ranges.

TABLE V-A-4 RANGE OF POSSIBLE TOTAL DIESEL FUEL PRICE INCREASES (CENTS PER GALLON) [a]

	Lower Limit	Mid-Point	Maximum
2007 500 ppm Sulfur Cap: Nonroad, Locomotive and Marine Diesel Fuel			
PADDs 1 and 3	0.9	1.5	3.4
PADD 2	2.3	3.0	4.8
PADD 4	1.7	4.1	5.8
PADD 5	1.0	2.8	4.3
2010 15 ppm Sulfur Cap: Nonroad Diesel Fuel			
PADDs 1 and 3	1.8	3.0	5.4
PADD 2	2.9	6.1	7.4
PADD 4	3.0	8.9	9.3
PADD 5	1.7	5.9	8.4

Notes:
[a] At the current wholesale price of approximately $1.00 per gallon, these values also represent the percentage increase in diesel fuel price.

The lower end of the range assumes that prices within a PADD increased to reflect the highest operating cost increase faced by any refiner in that PADD. In this case, this refiner with the highest operating cost would not recover any of his invested capital, but all other refiners would recover some or all of their investment. In this case, the price of nonroad, locomotive and marine diesel fuel would increase in 2007 by 1-2 cents per gallon, depending on the area of the country. In 2010, the price of nonroad diesel fuel would increase a total of 2-3 cents per gallon. Locomotive and marine diesel fuel prices would continue to increase by 1-2 cents per gallon.

The mid-range estimate of price impacts assumes that prices within a PADD increase by the average refining and distribution cost within that PADD, including full recovery of capital (at 7 percent per annum before taxes). Lower cost refiners would recover more than their capital investment, while those with higher than average costs recover less. Under this assumption, the price of nonroad, locomotive and marine diesel fuel would increase in 2007 by 2-4 cents per gallon, depending on the area of the country. In 2010, the price of nonroad diesel fuel would increase a total of 3-9 cents per gallon. Locomotive and marine diesel fuel prices would continue to increase by 2-4 cents per gallon.

The upper end estimate of price impacts assumes that prices within a PADD increase by the maximum total refining and distribution cost of any refinery within that PADD, including full recovery of capital (at 7 percent per annum before taxes). All other refiners would recover more than their capital investment. Under this assumption, the price of nonroad, locomotive and marine diesel fuel would increase in 2007 by 3-6 cents per gallon, depending on the area of the country. In 2010, the price of nonroad diesel fuel would increase a total of 5-9 cents per gallon. Locomotive and marine diesel fuel prices would continue to increase by 3-6 cents per gallon.

In addition to the differences noted above, there are a number of assumptions inherent in all three of the above price projections. First, both the lower and upper limits of the projected price impacts described above assume that the refinery facing the highest compliance costs is currently the price setter in their market. This is a worse case assumption which is impossible to validate. Many factors affect a refinery's total costs of fuel production. Most of these factors, such as crude oil cost, labor costs, age of equipment, etc., are not considered in projecting the incremental costs associated with lower NRLM diesel fuel sulfur levels. Thus, current prices may very well be set in any specific market by a refinery facing lower incremental compliance costs than other refineries. This point was highlighted in a study by the National Economic Research Associates (NERA) for AAM of the potential price impacts of EPA's 2007 highway diesel fuel program.[286] In that study, NERA criticized the above referenced study performed by Charles River Associates, *et. al.* for API, which projected that prices would increase nationwide to reflect the total cost faced by the U.S. refinery with the maximum total compliance cost of all the refineries in the U.S. producing highway diesel fuel To reflect the potential that the refinery with the highest projected compliance costs under the maximum price scenario is not the current price setter, we included the mid-point price impacts above. It is possible that even the lower limit price impacts are too high, if the conditions exist where prices are set based on operating costs alone. However, these price impacts are sufficiently low that considering even lower price impacts was not considered critical to estimating the potential economic impact of this rule.

Second, we assumed that a single refinery's costs could affect fuel prices throughout an entire PADD. While this is a definite improvement over analyses which assume that a single refinery's costs could affect fuel prices throughout the entire nation, it is still conservative. High cost refineries are more likely to have a more limited geographical impact on market pricing than an entire PADD.

Third, by focusing solely on the cost of desulfurizing NRLM diesel fuel, we assume that the production of NRLM diesel fuel is independent of the produciton of other refining products, such as gasoline, jet fuel and highway diesel fuel. However, this is clearly not the case. Refiners

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[286] "Potential Impacts of Environmental Regulations on Diesel Fuel Prices," NERA, for AAM, December 2000.

have some flexibility to increase the production of one product without significantly affecting the others, but this flexibility is quite limited. It is possible that the relative economics of producing other products could influence a refiner's decision to increase or decrease the production of NRLM diesel fuel under the proposed standards. This in turn could increase or decrease the price impact relative to those projected above.

Fourth, all three of the above price projections are based on the projected cost for U.S. refineries of meeting the proposed NRLM diesel fuel sulfur caps. Thus, these price projections assume that imports of NRLM fuel, which are currently significant in the Northeast, are available at roughly the same cost as those for U.S. refineries in PADDs 1 and 3. We have not performed any analysis of the cost of lower sulfur caps on diesel fuel produced by foreign refiners. However, there are reasons to believe that imports of 500 and 15 ppm NRLM diesel fuel would be available at prices in the ranges of those projected for U.S. refiners.

One recent study analyzed the relative cost of lower sulfur caps for Asian refiners relative to those in the U.S., Europe and Japan.[287] It concluded that costs for Asian refiners would be comparatively higher, due to the lack of current hydrotreating capacity at Asian refineries. This conclusion is certainly valid when evaluating lower sulfur levels for highway diesel fuels which are already at low levels in the U.S., Europe and Japan and for which refineries in these areas have already invested in hydrotreating capacity. It would appear to be less valid when assessing the relative cost of meeting lower sulfur standards for nonroad diesel fuels and heating oils which are currently at much higher sulfur levels in the U.S., Europe and Japan. All refineries face additional investments to remove sulfur from these fuels and so face roughly comparable control costs on a per gallon basis.

One factor arguing for competitively priced imports is the fact that refinery utilization rates are currently higher in the U.S. and Europe than in the rest of the world. The primary issue is whether overseas refiners will invest to meet tight sulfur standards for U.S., European and Japanese markets. Many overseas refiners will not invest, instead focusing on local, higher sulfur markets. However, many overseas refiners focus on exports. Both Europe and the U.S. are moving towards highway and nonroad diesel fuel sulfur caps in the 10-15 ppm range. Europe is currently and projected to continue to need to import large volumes of highway diesel fuel. Thus, it seems reasonable to expect that a number of overseas refiners would invest in the capacity to produce some or all of their diesel fuel at these levels. Overseas refiners also have the flexibility to produce 10-15 ppm diesel fuel from their cleanest blendstocks, as most of their available markets have less stringent sulfur standards. Thus, there are reasons to believe that some capacity to produce 10-15 ppm diesel fuel would be available overseas at competitive prices. If these refineries were operating well below capacity, they might be willing to supply complying product at prices which only reflect incremental operating costs. This could hold prices down in areas where importing fuel is economical. However, it is unlikely that these refiners could supply sufficient volumes to hold prices down nationwide. Despite this expectation, to be conservative, in the refining cost analysis conducted earlier in this chapter, we assumed no imports of 500 ppm

[287] "Cost of Diesel Fuel Desulfurization In Asian Refineries," Estrada International Ltd., for the Asian Development Bank, December 17, 2002.

or 15 ppm NRLM diesel fuel. All 500 ppm and 15 ppm nonroad diesel fuel was produced by domestic refineries. This raised the average and maximum costs of 500 ppm and 15 ppm NRLM diesel fuel and increased the potential price impacts projected above beyond what would have been projected had we projected that 5-10 percent of NRLM diesel fuel would be imported at competitive prices.

B. Cost Savings to the Existing Fleet from the Use of Low Sulfur Fuel

We estimate that reducing fuel sulfur to 500 ppm would reduce engine wear and oil degradation to the existing nonroad diesel equipment fleet and that a further reduction to 15 ppm sulfur would result in even greater reductions. This reduction in wear and oil degradation would provide a dollar savings to users of nonroad equipment. The cost savings would also be realized by the owners of future nonroad engines that are subject to the standards in this proposal. As discussed below, these maintenance savings have been conservatively estimated to be greater than 3 cents per gallon for the use of 15 ppm sulfur fuel when compared to the use of today's unregulated nonroad diesel fuel. A summary of the benefits of low-sulfur fuel is presented in Table V.B-1.[288]

TABLE V.B-1 -- ENGINE COMPONENTS POTENTIALLY AFFECTED BY LOWER SULFUR LEVELS IN DIESEL FUEL

Affected Components	Effect of Lower Sulfur	Potential Impact on Engine System
Piston Rings	Reduced corrosion wear	Extended engine life and less frequent rebuilds
Cylinder Liners	Reduced corrosion wear	Extended engine life and less frequent rebuilds
Oil Quality	Reduced deposits, reduced acid build-up, and less need for alkaline additives	Reduce wear on piston ring and cylinder liner and less frequent oil changes
Exhaust System (tailpipe)	Reduced corrosion wear	Less frequent part replacement
Exhaust Gas Recirculation System	Reduced corrosion wear	Less frequent part replacement

The monetary value of these benefits over the life of the equipment will depend upon the length of time that the equipment operates on low-sulfur diesel fuel and the degree to which

[288] See Heavy-duty 2007 Highway Final RIA, Chapter V.C.5, and "Study of the Effects of Reduced Diesel Fuel Sulfur Content on Engine Wear", EPA report # 460/3-87-002, June 1987.

engine and equipment manufacturers specify new maintenance practices and the degree to which equipment operators change engine maintenance patterns to take advantage of these benefits. For equipment near the end of its life in the 2008 time frame, the benefits will be quite small. However, for equipment produced in the years immediately preceding the introduction of 500 ppm sulfur fuel, the savings would be substantial. Additional savings would be realized in 2010 when the 15 ppm sulfur fuel would be introduced

We estimate the single largest savings would be the impact of lower sulfur fuel on oil change intervals. The draft RIA presents our analysis for the oil change interval extension which would be realized by the introduction of 500 ppm sulfur fuel in 2007, as well as the additional oil extension which would be realized with the introduction of 15 ppm sulfur nonroad diesel fuel in 2010. As explained in the draft RIA, these estimates are based on our analysis of publically available information from nonroad engine manufacturers. Due to the wide range of diesel fuel sulfur which today's nonroad engines may see around the world, engine manufacturers specify different oil change intervals as a function of diesel sulfur levels. We have used this data as the basis for our analysis. Taken together, when compared to today's relatively high nonroad diesel fuel sulfur levels, we estimate the use of 15 ppm sulfur fuel will enable an oil change interval extension of 35 percent from today's products.

We present here a fuel cost savings attributed to the oil change interval extension in terms of a cents per gallon operating cost. We estimate that an oil change interval extension of 31 percent, as would be enabled by the use of 500 ppm sulfur fuel in 2007, results in a fuel operating costs savings of 3.0 cents per gallon for the nonroad fleet. We project an additional cost savings of 0.3 cents per gallon for the oil change interval extension which would be enabled by the use of 15 ppm sulfur beginning in 2010. Thus, for the nonroad fleet as a whole, beginning in 2010 nonroad equipment users can realize an operating cost savings of 3.3 cents per gallon compared to today's engine. This means that the end cost to the typical user for 15ppm sulfur fuel is approximately 1.5 cents per gallon (4.8 cent per gallon cost for fuel minus 3.3 cent per gallon maintenance savings). For a typical 100 horsepower nonroad engine this represents a net present value lifetime savings of more than $500.

These savings will occur without additional new cost to the equipment owner beyond the incremental cost of the low-sulfur diesel fuel, although these savings are dependent on changes to existing maintenance schedules. Such changes seem likely given the magnitude of the savings. We have not estimated the value of the savings from the other benefits listed in Table V.B-1, and therefore we believe the 3.3 cents per gallon savings is conservative as it only accounts for the impact of low sulfur fuel on oil change intervals.

C. Engine and Equipment Cost Impacts

The following sections briefly discuss the various engine and equipment cost elements considered for this proposal and present the total costs we have estimated; the reader is referred to the draft RIA for a complete discussion. Estimated engine and equipment costs depend largely on both the size of the piece of equipment and its engine, and on the technology package being added to the engine to ensure compliance with the proposed standards. The wide size variation (e.g., <4 horsepower engines through >2500 horsepower engines) and the broad application variation (e.g., lawn equipment through large mining trucks) that exists in the nonroad industry makes it difficult to present here an estimated cost for every possible engine and/or piece of equipment. Nonetheless, for illustrative purposes, we present some example per engine/equipment cost impacts throughout this discussion. This analysis is presented in detail in Chapter 6 of the draft RIA. We are also considering doing a sensitivity analysis on cost/engine data, which would be put into the docket for comment.

It is important to note that the costs presented here do not reflect any savings that are expected to occur because of the engine ABT program and the equipment manufacturer transition program, both of which are discussed in Section VII. As discussed in the draft RIA, these optional programs have the potential to provide significant savings for both engine and equipment manufacturers. We request comment with supporting data and/or analysis on the cost estimates presented here and the underlying analysis presented in Chapter 6 of the draft RIA.

1. Engine Cost Impacts

Estimated engine costs are broken into fixed costs (for research and development, retooling, and certification), variable costs (for new hardware and assembly time), and life-cycle operating costs. Total operating costs include the estimated incremental cost for low-sulfur diesel fuel, any expected increases in maintenance costs associated with new emission control devices, any costs associated with increased fuel consumption, and any decreases in operating cost (i.e., maintenance savings) expected due to low-sulfur fuel. Cost estimates presented here represent an expected incremental cost of engines in the model year of their introduction. Costs in subsequent years would be reduced by several factors, as described below. All engine and equipment costs are presented in 2001 dollars.

a. Engine Fixed Costs

i. Engine and Emission Control Device R&D

The technologies described in Section III represent those technologies we believe will be used to comply with the proposed Tier 4 emission standards. These technologies are part of an ongoing research and development effort geared toward compliance with the 2007 heavy-duty diesel highway emission standards. The engine manufacturers making R&D expenditures toward compliance with highway emission standards will have to undergo some additional R&D effort to transfer emission control technologies to engines they wish to sell into the nonroad market. These R&D efforts will allow engine manufacturers to develop and optimize these new technologies for maximum emission-control effectiveness with minimum negative impacts on engine performance, durability, and fuel consumption. Many nonroad engine manufacturers are not part of the ongoing R&D effort toward compliance with highway emissions standards because they do not sell engines into the highway market. These manufacturers are expected to benefit from the R&D work that has already occurred and will continue through the coming years through their contact with highway manufacturers, emission control device manufacturers, and the independent engine research laboratories conducting relevant R&D.

Several technologies are projected for complying with the proposed Tier 4 emission standards. We are projecting that NOx adsorbers and catalyzed diesel particulate filters (CDPFs) would be the most likely technologies applied by industry to meet our proposed emissions standards for >75 horsepower engines. The fact that these technologies are being developed for implementation in the highway market prior to the implementation dates in this proposal, and the fact that engine manufacturers would have several years before implementation of the proposed Tier 4 standards, ensures that the technologies used to comply with the nonroad standards would undergo significant development before reaching production. This ongoing development could lead to reduced costs in three ways. First, we expect research will lead to enhanced effectiveness for individual technologies, allowing manufacturers to use simpler packages of emission control technologies than we would predict given the current state of development. Similarly, we anticipate that the continuing effort to improve the emission control technologies will include innovations that allow lower-cost production. Finally, we believe that manufacturers would focus research efforts on any drawbacks, such as fuel economy impacts or maintenance costs, in an effort to minimize or overcome any potential negative effects.

We anticipate that, in order to meet the proposed standards, industry would introduce a combination of primary technology upgrades. Achieving very low NOx emissions would require basic research on NOx emission control technologies and improvements in engine management to take advantage of the exhaust emission control system capabilities. The manufacturers are expected to take a systems approach to the problem of optimizing the engine and exhaust emission control system to realize the best overall performance. Since most research to date with exhaust emission control technologies for nonroad applications has focused on retrofit programs, there remains room for significant improvements by taking such a systems approach. The NOx adsorber technology in particular is expected to benefit from re-optimization of the engine management system to better match the NOx adsorber's performance characteristics. The majority of the dollars we have estimated for research is expected to be spent on developing this synergy between the engine and NOx exhaust emission control systems. Therefore, for engines requiring both a CDPF and a NOx adsorber (i.e., >75 horsepower), we have attributed two-thirds of the R&D expenditures to NOx control, and one-third to PM control.

In the 2007 HD highway rule, we estimated that each engine manufacturer would expend $35 million for R&D to redesign their engines and apply catalyzed diesel particulate filters (CDPF) and NOx adsorbers. For their nonroad R&D efforts on engines requiring CDPFs and NOx adsorbers (i.e., >75 horsepower), engine manufacturers selling into the highway market would incur some level of R&D effort but not at the level incurred for the highway rule. In many cases, the engines used by highway manufacturers in nonroad products are based on the same engine platform as those used in highway products. However, horsepower and torque characteristics are often different so some effort will have to be expended to accommodate those differences. For these manufacturers, we have estimated that they would incur an R&D expense of $3.5 million. This $3.5 million R&D expense would allow for the transfer of R&D knowledge from their highway experience to their nonroad engine product line. Two-thirds of this R&D is attributed to NOx control and one-third to PM control.

For those manufacturers that sell engines only into the nonroad market, and where those engines require a CDPF and a NOx adsorber, we believe that they will incur an R&D expense nearing that incurred by highway manufacturers for the highway rule, although not at the level incurred by highway manufacturers for the highway rule. Nonroad manufacturers would be able to learn from the R&D efforts already underway for both the highway rule and for the Tier 2 light-duty highway rule (65 FR 6698). This learning could be done via seminars, conferences, and contact with highway manufacturers, emission control device manufacturers, and the independent engine research laboratories conducting relevant R&D. Therefore, for these manufacturers, we have estimated an expenditure of $24.5 million. This lower number – $24.5 million versus $35 million in the highway rule – reflects the transfer of knowledge to nonroad manufacturers that would occur from the many stakeholders in the diesel industry. Two-thirds of this R&D is attributed to NOx control and one-third to PM control.

Note that the $3.5 million and $24.5 million estimates represent our estimate of the average R&D expected by manufacturers. These estimates would be different for each manufacturer – some higher, some lower – depending on product mix and the ability to transfer knowledge from one product to another.

For those engine manufacturers selling engines that would require CDPF-only R&D (i.e., 25 to 75 horsepower engines in 2013), we have estimated that the R&D they would incur would be roughly one-third that incurred by manufacturers conducting CDPF/NOx adsorber R&D. We believe this is a good estimate because CDPF technology is further along in its development than is NOx adsorber technology and, therefore, a 50/50 split would not be appropriate. Using this estimate, the R&D incurred by manufacturers that have already done selling any engines into both the highway and the nonroad markets would be $1.2 million, and the R&D for manufacturers selling engines into only the nonroad market would be roughly $8 million. All of this R&D is attributed to PM control.

For those engine manufacturers selling engines that would require DOC-only or some engine-out modification R&D (i.e., <75 horsepower engines in 2008), we have estimated that the R&D they would incur would be roughly one-half the amount estimated for their CDPF-only R&D. Using this estimate, the R&D incurred by manufacturers selling any engines into both the highway and nonroad markets would be roughly $600,000, and the R&D for manufacturers selling engines into only the nonroad market would be roughly $4 million. All of this R&D is attributed to PM control.

Some manufacturers of engines produce engines to specifications developed by other manufacturers. Such joint venture manufacturers do not conduct engine-related R&D but simply manufacture an engine designed and developed by another manufacturer. For such manufacturers, we have assumed no R&D expenditures given that we believe they will conduct no R&D themselves and will rely on their joint venture partner. This is true unless the parent company has no engine sales in the horsepower categories covered by the partner company. Under such a situation, we have accounted for the necessary R&D by attributing it to the parent company. We have also estimated that some manufacturers will choose not to invest in R&D for the US nonroad market due to low volume sales that probably cannot justify the expense. More detail on these assumptions and the number of manufacturers assumed not to expend R&D is presented in Chapter 6 of the draft RIA. We welcome comments and supporting documentation.

We have assumed that all R&D expenditures occur over a five year span preceding the first year any emission control device is introduced into the market. Where a phase-in exists (e.g., for NOx standards on >75 horsepower engines), expenditures are assumed to occur over the five year span preceding the first year NOx adsorbers would be introduced, and then to continue during the phase-in years; the expenditures would be incurred in a manner consistent with the phase-in of the standard. All R&D expenditures are then recovered by the engine manufacturer over an identical time span following the introduction of the technology. We assume a seven percent rate of return for all R&D. We have apportioned these R&D costs across all engines that are expected to use these technologies, including those sold in other countries or regions that are expected to have similar standards. We have estimated the fraction of the U.S. sales to this total sales at 42 percent. Therefore, we have attributed this amount to U.S. sales.

Using this methodology, we have estimated the total R&D expenditures attributable to the proposed standards at $199 million.

ii. Engine-Related Tooling Costs

Once engines are ready for production, new tooling will be required to accommodate the assembly of the new engines. In the 2007 highway rule, we estimated approximately $1.6 million per engine line for tooling costs associated with CDPF/NOx adsorber systems. For the proposed nonroad Tier 4 standards, we have estimated that nonroad-only manufacturers would incur the same $1.6 million per engine line requiring a CDPF/NOx adsorber system and that these costs would be split evenly between NOx control and PM control. For those systems requiring only a CDPF, we have estimated one-half that amount, or $800,000 per engine line. For those systems requiring only a DOC or some engine-out modifications, we have applied a one-half factor again, or $400,000 per engine line. Tooling costs for CDPF-only and for DOC engines are attributed solely to PM control.

For those manufacturers selling into both the highway and nonroad markets, we have estimated one-half the baseline tooling cost, or $800,000, for those engine lines requiring a CDPF/NOx adsorber system. We believe this is reasonable since many nonroad engines are produced on the same engine line with their highway counterparts. For such lines, we believe very little to no tooling costs would be incurred. For engine lines without a highway counterpart, something approaching the $1.6 million tooling cost would be applicable. For this analysis, we have assumed a 50/50 split of engine product lines for highway manufacturers and, therefore, a 50 percent factor applied to the $1.6 million baseline. These tooling costs would be split evenly between NOx control and PM control. For engine lines <75 horsepower, we have used the same tooling costs as the nonroad-only manufacturers because these engines tend not to have a highway counterpart. Therefore, for those engine lines requiring only a CDPF (i.e., those between 25 and

75 horsepower), we have estimated a tooling cost of $800,000. Similarly, the tooling costs for DOC and/or engine-out engine lines has been estimated to be $400,000. Tooling costs for CDPF-only and for DOC engines are attributed solely to PM control.

We expect engines in the 25 to 50 horsepower range to apply EGR systems to meet the proposed NOx standards for 2013. For these engines, we have included an additional tooling cost of $40,000 per engine line, consistent with the EGR-related tooling cost estimated for 50-100 horsepower engines in our Tier 2/3 rulemaking. This tooling cost is applied equally to all engine lines in that horsepower range regardless of the markets into which the manufacturer sells. We have applied this tooling cost equally because engines in this horsepower range do not tend to have highway counterparts. Tooling costs for EGR systems are attributed solely to NOx control.

We have applied all the above tooling costs to all manufacturers that appear to actually make engines. We have not eliminated joint venture manufacturers because these manufacturers would still need to invest in tooling to make the engines even if they do not conduct any R&D. We have assumed that all tooling costs are incurred one year in advance of the new standard and are recovered over a five year period following implementation of the new standard; all tooling costs are marked up seven percent to reflect the time value of money. As done for R&D costs, we have attributed a portion of the tooling costs to U.S. sales and a portion to sales in other countries expected to have similar levels of emission control. More information is contained in Chapter 6 of the draft RIA and we request comment on how we have applied our tooling cost estimates and to whom we have applied them.

Using this methodology, we estimate the total tooling expenditures attributable to the proposed standards at $67 million.

iii. Engine Certification Costs

Manufacturers will incur more than the normal level of certification costs during the first few years of implementation because engines will need to be certified to the new emission standards. Consistent with our recent standard setting regulations, we have estimated engine certification costs at $60,000 per new engine certification to cover testing and administrative costs. To this we have added the proposed certification fee of $2,156 per new engine family. This cost, $62,156 per engine family was used for <75 horsepower engines certifying to the 2008 standards. For 25 to 75 horsepower engines certifying to the 2013 standards, and for >75 horsepower engines certifying to their proposed standards, we have added costs to cover the proposed test procedures for nonroad diesel engines (i.e., the transient test and the NTE); these costs were estimated at $10,500 per engine family. These certification costs – whether it be the $62,156 or the $72,656 per engine family – apply equally to all engine families for all manufacturers regardless of into what markets the manufacturer sells. We have applied these certification costs to only the US sold engines because the certification conducted for US sales is not presumed to fulfill the certification requirements of other countries.

Applying these costs to each of the 665 engine families as they are certified to a new emissions standard results in total costs of $72 million expended during implementation of the proposed standards. These costs are attributed to NOx and PM control consistent with the phase-in of the new emissions standards – where new NOx and PM standards are introduced together, the certification costs are split evenly; where only a new PM standard is introduced, the certification costs are attributed to PM only; where a NOx phase-in becomes 100% in a year after full implementation of a PM standard, the certification costs are attributed to NOx only. All certification costs are assumed to occur one year prior to the new emission standard and are then recovered over a five year period following compliance with the new standard; all certification costs are marked up seven percent to reflect the time value of money.

b. Engine Variable Costs

This section summarizes the detailed analysis presented in the draft RIA for this proposed rule. We encourage the reader to refer to Chapter 6 of that draft RIA for the details of what is presented here and encourage comments and supporting data and/or analysis regarding those details. Of particular interest are comments regarding the costs of precious metals, or platinum group metals (PGM). The PGM costs are a significant fraction of the total costs for aftertreatment devices. For our analysis, we have used the 2002 annual average costs for platinum and rhodium (the two PGMs we expect will be used) because we believe they represent a better estimate of the cost for PGM than other metrics. We request comment on this approach and whether an alternative approach would be more appropriate. Specifically, we request comment regarding the use of a five year average in place of the one year average we have used. Additionally, EPA invites comment on the impacts, if any, that this rulemaking would have in the context of a variety of rulemakings on the market impacts on precious metals.

i. NOx Adsorber System Costs

The NOx adsorber system that we are anticipating would be applied for Tier 4 would be the same as that used for highway applications. In order for the NOx adsorber to function properly, a systems approach that includes a reductant metering system and control of engine A/F ratio is also necessary. Many of the new air handling and electronic system technologies developed in order to meet the Tier 2/3 nonroad engine standards can be applied to accomplish the NOx adsorber control functions as well. Some additional hardware for exhaust NOx or O_2 sensing and for fuel metering will likely be required. The cost estimates include a DOC for clean-up of hydrocarbon emissions that occur during NOx adsorber regeneration events. We have also assumed that warranty costs would increase due to the application of this new hardware. Chapter 6 of the draft RIA contains the details for how we estimated costs associated with the new NOx control technologies required to meet the proposed Tier 4 emission standards. These costs are estimated to increase engine costs by roughly $670 in the near-term for a 150 horsepower engine, and $2,070 in the near-term for a 500 horsepower engine. In the long-term, we estimate these costs to be $550 and $1,670 for the 150 horsepower and 500 horsepower engines, respectively. Note that we have estimated costs for all engines in all horsepower ranges, and these estimates are presented in detail in the draft RIA. Throughout this discussion of engine and equipment costs, we present costs for a 150 and a 500 horsepower engine for illustrative purposes.

ii. Catalyzed Diesel Particulate Filter (CDPF) Costs

CDPFs can be made from a wide range of filter materials including wire mesh, sintered metals, fibrous media, or ceramic extrusions. The most common material used for CDPFs for heavy-duty diesel engines is cordierite. He we have based our cost estimates on the use of silicon carbide (SiC) even though it is more expensive than other filter materials. We request comment on our assumption that SiC will be used in favor of cordierite. We estimate that the CDPF systems will add $780 to engine costs in the near-team for a 150 horsepower engine and $2,770 in the near-term for a 500 horsepower engine. In the long-term, we estimate these CDPF system costs to be $590 and $2,110 for the 150 horsepower and the 500 horsepower engines, respectively.

iii. CDPF Regeneration System Costs

Application of CDPFs in nonroad applications is expected to present challenges beyond those of highway applications. For this reason, we anticipate that some additional hardware beyond the diesel particulate filter itself may be required to ensure that CDPF regeneration occurs. For some engines this may be new fuel control strategies that force regeneration under some circumstances, while in other engines it might involve an exhaust system fuel injector to inject fuel upstream of the CDPF to provide necessary heat for regeneration under some operating conditions. We estimate the near-term costs of a CDPF regeneration system to be $190 for a 150 horsepower engine and $320 for a 500 horsepower engine. In the long-term, we estimate these costs at $140 and $240, respectively.

iv. Closed-Crankcase Ventilation System (CCV) Costs

We are proposing to eliminate the exemption that allows turbo-charged nonroad diesel engines to vent crankcase gases directly to the environment. Such engines are said to have an open crankcase system. We project that this requirement to close the crankcase on turbo-charged engines would force manufacturers to rely on engineered closed crankcase ventilation systems that filter oil from the blow-by gases prior to routing them into either the engine intake or the exhaust system upstream of the CDPF. We have estimated the initial cost of these systems to be roughly $40 for low horsepower engines and up to $100 for very high horsepower engines. These costs are incurred only by turbo-charged engines because today's naturally aspirated engines already have CCV systems.

v. Variable Costs for Engines Below 75 Horsepower and Above 750 Horsepower

This proposal includes standards for engines <25 horsepower that begin in 2008, and two sets of standards for 25 to 75 horsepower engines – one set that begins in 2008 and another that begins in 2013. The 2008 standards for all engines <75 horsepower are of similar stringency and are expected to result in similar technologies (i.e., the addition of a DOC). The 2013 standards for 25 to 75 horsepower engines are considerably more stringent than the 2008 standards and are expected to force the addition of a CDPF along with some other engine hardware to enable the proper functioning of that new technology. More detail on the mix of technologies expected for all engines <75 horsepower is presented in Section III. As discussed there, if changes are needed to comply, we expect manufacturers to comply with the 2008 standards through either engine improvements or through the addition of a DOC. From a cost perspective, we have projected that engines would comply by either adding a DOC or by making some engine modifications resulting in engine-out emission reductions. Presumably, the manufacturer would choose the least costly approach that provided the necessary reduction. If engine-out modifications are less costly than a DOC, our estimate here is conservative. If the DOC proves to be less costly, then our estimate is representative of what most manufacturers would do. Therefore, we have assumed that, beginning in 2008, all engines below 75 horsepower add a DOC. Note that this is a conservative estimate in that we have assume this cost for all engines when, as discussed in Section IV, some engines <75 horsepower already meet the proposed PM standards. We have estimated this added hardware to result in an increased engine cost of $150 in the near-term and $140 in the long-term for a 30 horsepower engine.

We have also projected that some engines in the 25 to 75 horsepower range would have to upgrade their fuel systems to accommodate the CDPF. We have estimated the incremental costs for these fuel systems at roughly $740 in the 25-50 horsepower range, and around $430 in the 50-75 horsepower range. This difference reflects a different base fuel system, with the smaller engines assumed to have mechanical fuel systems and the larger engines assumed to already be electronic. The electronic systems will incur lower costs because they already have the control unit and electronic fuel pump. Also, we have assumed these fuel changes would occur for only direct injection (DI) engines; indirect injection engines (IDI) are assumed to remain IDI but to add more hardware as part of their CDPF regeneration system to ensure proper regeneration under all operating conditions. Such a regeneration system, described above, is expected to cost roughly twice that expected for DI engines, or around $320 for a 30 horsepower IDI engine versus $160 for a DI engine.

We have also projected that engines in the 25-50 horsepower range would add cooled EGR to comply with their new NOx standard. We have estimated that this would add $90 in the near-term and $70 in the long-term to the cost of a 30 horsepower engine.

We believe there are factors that would cause variable hardware costs to decrease over time, making it appropriate to distinguish between near-term and long-term costs. Research in the costs of manufacturing has consistently shown that as manufacturers gain experience in production, they are able to apply innovations to simplify machining and assembly operations, use lower cost materials, and reduce the number or complexity of component parts.[289] Our analysis, as described in more detail in the draft RIA, incorporates the effects of this learning curve by projecting that the variable costs of producing the low-emitting engines decreases by 20 percent starting with the third year of production. For this analysis, we have assumed a baseline that represents such learning already having occurred once due to the 2007 highway rule (i.e., a 20 percent reduction in emission control device costs is reflected in our near-term costs). We have then applied a single learning step from that point in this analysis. We invite comment on this methodology to account for the learning curve phenomenon and also request comment on whether

[289] "Learning Curves in Manufacturing," Linda Argote and Dennis Epple, *Science,* February 23, 1990, Vol. 247, pp. 920-924.

learning is likely to reduce costs even further in this industry (e.g., should a second learning step be applied to our near-term costs?). Additionally, manufacturers are expected to apply ongoing research to make emission controls more effective and to have lower operating costs over time. However, because of the uncertainty involved in forecasting the results of this research, we conservatively have not accounted for it in this analysis.

c. Engine Operating Costs

We are projecting that a variety of new technologies will be introduced to enable nonroad engines to meet the proposed Tier 4 emissions standards. Primary among these are advanced emission control technologies and low-sulfur diesel fuel. The technology enabling benefits of low-sulfur diesel fuel are described in Section III, and the incremental cost for low-sulfur fuel is described in Section V.A. The new emission control technologies are themselves expected to introduce additional operating costs in the form of increased fuel consumption and increased maintenance demands. Operating costs are estimated in the draft RIA over the life of the engine and are expressed in terms of cents/gallon of fuel consumed. In Section V.C.3, we present these lifetime operating costs as a net present value (NPV) in 2001 dollars for several example pieces of equipment.

Total operating cost estimates include the following elements: the change in maintenance costs associated with applying new emission controls to the engines; the change in maintenance costs associated with low sulfur fuel such as extended oil change intervals; the change in fuel costs associated with the incrementally higher costs for low sulfur fuel, and the change in fuel costs due to any fuel consumption impacts associated with applying new emission controls to the engines. This latter cost is attributed to the CDPF and its need for periodic regeneration which we estimate may result in a one percent fuel consumption increase where a NOx adsorber is also applied, or a two percent fuel consumption increase where no NOx adsorber is applied (refer to Chapter 6, section 6.2.3.3). Maintenance costs associated with the new emission controls on the engines are expected to increase since these devices represent new hardware and, therefore, new maintenance demands. For CDPF maintenance, we have used a maintenance interval of 3,000 hours for smaller engines and 4,500 hours for larger engines and a cost of $65 through $260 for each maintenance event. For closed-crankcase ventilation (CCV) systems, we have used a maintenance interval of 675 hours for all engines and a cost per maintenance event of $8 to $48 for small to large engines. Offsetting these maintenance cost increases would be a savings due to an expected increase in oil change intervals because low sulfur fuel would be far less corrosive than is current nonroad diesel fuel. Less corrosion would mean a slower acidification rate (i.e., less degradation) of the engine lubricating oil and, therefore, more operating hours between needed oil changes. As discussed in Section V.B, the use of 15 ppm sulfur fuel can extend oil change intervals by as much as 35 percent for both new and existing nonroad engines and equipment. We have used a 35 percent increase in oil change interval along with costs per oil change of $70 through $400 to arrive at estimated savings associated with increased oil change intervals.

These operating costs are expressed as a cent/gallon cost (or savings). As a result, operating costs are directly proportional to the amount of fuel consumed by the engine. We have estimated these operating costs, inclusive of fuel-related costs, to be 3.4 cents/gallon for a 150 horsepower engine and 4.2 cents/gallon for a 500 horsepower engine. More detail on operating costs can be found in Chapter 6 of the draft RIA.

The existing fleet will also benefit from lower maintenance costs due to the use of low sulfur diesel fuel. The operating costs for the existing fleet are discussed in Section V.B.

2. Equipment Cost Impacts

In addition to the costs directly associated with engines that incorporate new emission controls to meet new standards, we expect cost increases due to the need to redesign the nonroad equipment in which these engines are used. Such redesigns would probably be necessary due to the expected addition of new emission control systems, but could also occur if the engine has a different shape or heat rejection rate, or is no longer made available in the configuration previously used. Based on their past experiences, equipment manufacturers have told EPA that a major concern with a new standard is their ability to redesign a large number of applications in a short period of time. Therefore, we have provided equipment manufacturers transition flexibility provisions to help them avoid business disruptions resulting from the changes associated with new emission standards. These flexibility provisions are presented in detail in Section III.E.4.

In assessing the economic impact of the new emission standards, EPA has made a best estimate of the modifications to equipment that relate to packaging (installing engines in equipment engine compartments). The incremental costs for new equipment would be comprised of fixed costs (for redesign to accommodate new emission control devices) and variable costs (for new equipment hardware and for labor to install new emission control devices). Note that the fixed costs do not include certification costs, as did the engine fixed costs, because equipment is not certified to emission standards. We have attributed all changes in operating costs (e.g., additional maintenance) to the cost estimates for engines. Included in Section V.C.3 is a discussion of several example pieces of equipment (e.g., skid/steer loader, dozer, etc.) and the costs we have estimated for these specific example pieces of equipment Full details of our equipment cost analysis can be found in Chapter 6 of the draft RIA. All costs are presented in 2001 dollars.

a. Equipment Fixed Costs

The most significant changes anticipated for equipment redesign are changes to accommodate the physical changes to engines, especially for those engines that add PM traps and NOx adsorbers. The costs for engine development and the emission control devices are included as costs to the engines, as described above. What remains to be quantified for equipment manufacturers is the effort to integrate the engine and emissions control devices into the overall functioning of the equipment. What remains to be quantified for equipment manufacturers is the effort to integrate the engine and emissions control devices into the overall functioning of the equipment. We have allocated extensive engineering time for this effort.

The costs we have estimated are based on engine power and whether an application is non-motive (e.g., a generator set) or motive (e.g., a skid steer loader). The designs we have considered to be non-motive are those that lack a propulsion system. In addition, the proposed emission standards for engines rated under 25 horsepower and the proposed 2008 standards for 25-75 horsepower engines are projected to require no significant equipment redesign beyond that done to accommodate the Tier 2 standards. We expect that these engines would comply with the proposesd Tier 4 standards through either engine modifications to reduce engine-out emissions or through the addition of a DOC. We have projected that engine modifications would not affect the outer dimensions of the engine and that a DOC would replace the existing muffler. Therefore, either approach taken by the engine manufacturer should have minimal to no impact on the equipment design. Nonetheless, we have conservatively estimated their redesign costs at $50,000 per model.

A number of equipment manufacturers have shared detailed information with us regarding the investments made for Nonroad Tier 2 equipment redesign efforts, as well as redesign estimates for significant changes such as installing a new engine design. These estimates range from approximately $50,000 for some lower powered equipment models to well over $1 million dollars for high horsepower equipment with very challenging design constraints. Based on that input, for the proposed Tier 4 standards, we have estimated that equipment redesign costs would range from $50,000 per model for 25 horsepower equipment up to $750,000 per model for 300 horsepower equipment and above. We have attributed only a portion of the equipment redesign costs to US sales in a manner consistent with that taken for engine R&D costs and engine tooling costs. In addition, we expect manufacturers to incur some fixed costs to update service and operation manuals to address the maintenance demands of new emission control technologies and the new oil service intervals which we estimate to be between $2,500 and $10,000 per equipment model.

These equipment fixed costs (redesign and manual updates) were then allocated appropriately to each new model to arrive at a total equipment fixed cost of $697 million. We have assumed that these costs would be recovered over a ten year period at a seven percent interest rate.

b. Equipment Variable Costs

Equipment variable cost estimates are based on costs for additional materials to mount the new hardware (i.e., brackets and bolts required to secure the aftertreatment devices) and additional sheet metal assuming that the body cladding of a piece of equipment (i.e., the hood) might change to accommodate the aftertreatment system. Variable costs also include the labor required to install these new pieces of hardware. For engines >75 horsepower – those expected to incorporate CDPF and NOx adsorber technology – the amount of sheet metal is based on the size of the aftertreatment devices.

For equipment of 150 horsepower and 500 horsepower, respectively, we have estimated the costs to be roughly $60 to $140. Note that we have estimated costs for equipment in all horsepower ranges, and these estimates are presented in detail in the draft RIA. Throughout this discussion of engine and equipment costs, we present costs for a 150 and a 500 horsepower engine for illustrative purposes.

3. Overall Engine and Equipment Cost Impacts

To illustrate the engine and equipment cost impacts we are estimating for the proposed standards, we have chosen several example pieces of equipment and presented the estimated costs for them. Using these examples, we can calculate the costs for a specific piece of equipment in several horsepower ranges and better illustrate the cost impacts of the proposed standards. These costs along with information about each example piece of equipment are shown in Table V.C-1. Costs presented are near-term and long-term costs for the final standards to which each piece of equipment would comply. Long-term costs are only variable costs and, therefore, represent costs after all fixed costs have been recovered and all projected learning has taken place. Included in the table are estimated prices for each piece of equipment to provide some perspective on how our estimated control costs relate to existing equipment prices.

TABLE V.C-1 -- NEAR-TERM AND LONG-TERM COSTS FOR SEVERAL EXAMPLE PIECES OF EQUIPMENT[a]
($2001, FOR THE FINAL EMISSION STANDARDS TO WHICH THE EQUIPMENT MUST COMPLY)

	GenSet	Skid/Steer Loader	Backhoe	Dozer	Ag Tractor	Dozer	Off-Highway Truck
Horsepower	9 hp	33 hp	76 hp	175 hp	250 hp	503 hp	1000 hp
Incremental Engine & Equipment Cost							
Long-Term	$120	$760	$1,210	$2,590	$2,000	$4,210	$6,780
Near-Term	$170	$1,100	$1,680	$3,710	$2,950	$6,120	$10,100
Estimated Equipment Price when New[b]	$3,500	$13,500	$50,000	$235,000	$130,000	$575,000	$700,000
Incremental Operating Costs[c]	-$90	$40	$370	$1,550	$1,320	$4,950	$12,550
Baseline Operating Costs (Fuel & Oil only)[c]	$940	$2,680	$7,960	$77,850	$23,750	$77,850	$179,530

Notes:
[a] Near-term costs include both variable costs and fixed costs; long-term costs include only variable costs and represent those costs that remain following recovery of all fixed costs.
[b] "Estimated Price of New Nonroad Example Equipment," memorandum from Zuimdie Guerra to docket A-2001-28.
[c] Present value of lifetime costs.

More detail and discussion regarding what these costs and prices mean from an economic impact perspective can be found in Section V.E.

D. Annual Costs and Cost Per Ton

One tool that can be used to assess the value of the proposed standards for nonroad fuel and engines is the costs incurred per ton of emissions reduced. This analysis involves a comparison of our proposed program to other measures that have been or could be implemented.

We have calculated the cost per ton of our proposed program based on the net present value of all costs incurred and all emission reductions generated over a 30 year time window following implementation of the program. This approach captures all of the costs and emissions reductions from our proposed program including those costs incurred and emissions reductions generated by the existing fleet. The baseline (i.e., the point of comparison) for this evaluation is the existing set of fuel and engine standards (i.e., unregulated fuel and the Tier 2/Tier 3 program). The 30 year time window chosen is meant to capture both the early period of the program when very few new engines that meet the proposed standards would be in the fleet, and the later period when essentially all engines would meet the proposed standards.

As discussed in Section IV, the proposal contains two separate fuel programs. We are proposing a 500 ppm sulfur cap on nonroad, locomotive, and marine fuels beginning in 2007. This fuel program, the first step in our two step fuel program, provides significant air quality benefits through reduced SO_2 and PM emissions from both new and existing nonroad, locomotive, and marine engines. In Sections V.D.1 and 2, we summarize the cost for this program as if it remained in place for 30 years, even though it would be supplanted by the second step of our fuel program in 2010. We also provide an analysis of the cost per ton for the SO_2 reductions that would be realized by the 500 ppm fuel program for the same 30 year time window. In this way, the cost per ton of the SO_2 reductions realized by the 500 ppm fuel program can be compared to other available means to control SO_2 emissions. The significant PM reductions are not accounted for in the relative cost per ton estimate, but are accounted for in our inventory analysis presented in Section II and in the benefits analysis presented later in this section. Additional detail regarding all of the estimates presented here are available in the draft RIA.

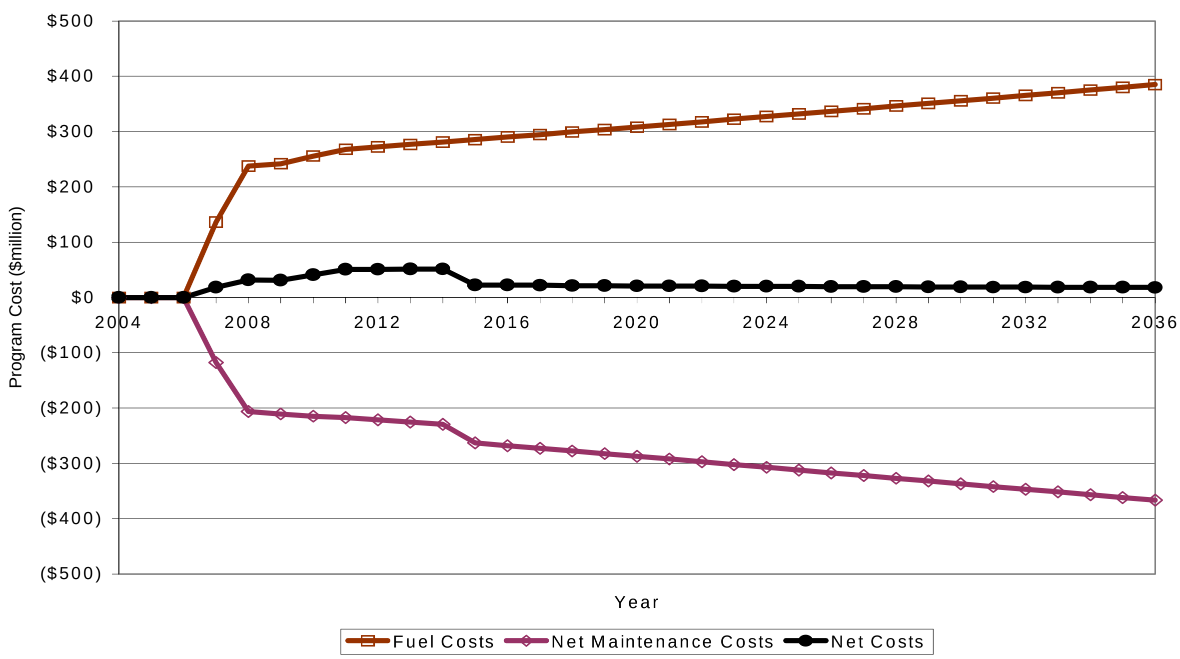
We are proposing a second step in the fuel program that would cap nonroad fuel sulfur levels at 15 ppm beginning in 2010. This fuel program enables the introduction of advanced emission control technologies including CDPFs and NOx adsorbers. The combination of the two-step fuel program and the new diesel engine standards represents the total Tier 4 program for nonroad diesel engines and fuel proposed today. In Sections V.D.3 and 4, we present our estimate of the annual and total costs for this complete program beginning in 2007 and continuing for 30 years. Also included is an estimate of the cost per ton of emissions reductions realized by this program for NMHC+NOx, PM, and SO_2.

1. Annual Costs for the 500 ppm Fuel Program

Cent per gallon costs for the proposed 500 ppm fuel program (i.e., the reduction to a 500 ppm sulfur cap) were presented in Section V.A. Having this fuel would result in maintenance savings associated with increased oil change intervals for both the new and the existing fleet of nonroad, locomotive, and marine engines. These maintenance savings were discussed in Section V.B. There are no engine and equipment costs associated with the 500 ppm fuel program because new emission standards are not part of that proposed program. Figure V.D-1 shows the annual costs associated with the 500 ppm fuel program.

As can be seen in Figure V.D-1, the costs for refining and distributing the 500 ppm fuel range from $250 million in 2008 to nearly $400 million in 2036. These control costs are largely offset by the maintenance savings that range from $200 million in 2008 to $380 million in 2036. Despite the fact that the costs of the 500 ppm fuel for nonroad diesel fuel is 2.5 cents/gallon and the maintenance savings are 3 cents per gallon, the net costs are positive because of the costs for the locomotive and marine fuel is not off-set by the maintenance savings. As a whole, the net cost of the program in each year is essentially zero, ranging from $50 million in the early years to only $18 million in 2036. The net present value of the net costs and savings associated with the proposed 500 ppm fuel program during the years 2007 to 2036 is estimated at $510 million.

FIGURE V.D-1 -- ANNUAL COSTS OF THE 500 PPM FUEL PROGRAM



2. Cost Per Ton for the 500 ppm Fuel Program

The 2007 fuel program would result in large reductions of both SO_2 and PM emissions. Roughly 98 percent of fuel sulfur is converted to SO_2 in the engine with the remaining two percent being exhausted as sulfate PM. Because the majority of the emissions reductions associated with this program would be SO_x, we have attributed all the control costs to SO_x in calculating the cost per ton associated with this program. However, we have modeled both the SO_x and PM reductions so that our inventory and benefits analysis fully account for them.

As noted above, we have calculated both the costs and emission reductions of the 500 ppm fuel program as if it were to remain in place indefinitely. Figure V.D-1 shows the costs in each year of the program, the net present value of which are estimated at $510 million. We have estimated the 30 year net present value of the SO_x emission reductions at 5.6 million tons.

Table V.D-1 shows the cost per ton of emissions reduced as a result of the proposed 500 ppm fuel program. The cost per ton numbers include costs and emission reductions that would occur from both the new and the existing fleet (i.e., those pieces of nonroad equipment that were sold into the market prior to the proposed emission standards) of nonroad, locomotive, and marine engines.

TABLE V.D-1 -- 500 PPM FUEL PROGRAM
AGGREGATE COST PER TON AND LONG-TERM ANNUAL COST PER TON
($2001)

Pollutant	2004-2036 Discounted Lifetime Cost per ton	Long-Term Cost per Ton in 2036
SO_x	$90	$50

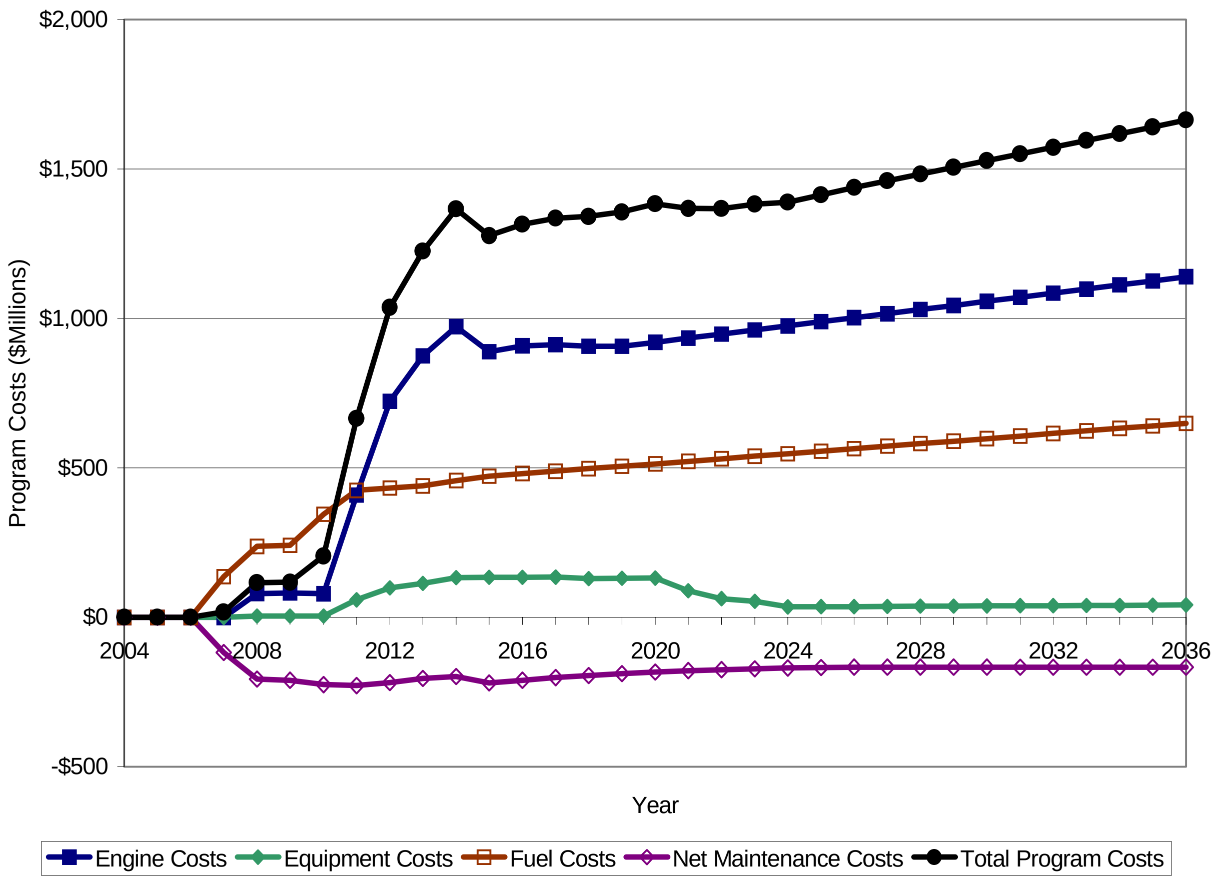
We also considered the cost per ton of the 500 ppm fuel program without taking credit for the expected maintenance savings associated with low sulfur fuel. Without the maintenance savings, the cost per ton of SO_x reduced would be $990 per ton for each year of the program. More detail on how the costs and cost per ton numbers associated with the 500 ppm fuel program were calculated can be found in the draft RIA.

3. Annual Costs for the Proposed Two-Step Fuel Program and Engine Program

The costs of the total proposed engine and fuel program include costs associated with both steps in the fuel program – the reduction to 500 ppm sulfur in 2007 and the reduction to 15 ppm sulfur in 2010. Also included are costs for the proposed 2008 engine standards for <75 horsepower engines, the proposed 2013 standards for 25 to 75 horsepower engines, and costs for the proposed engine standards for >75 horsepower engines. Included are all maintenance costs and savings realized by both the existing fleet (nonroad, locomotive, and marine) and the new fleet of engines complying with the proposed standards.

Figure V.D-2 presents these results. All capital costs for fuel production and engine and equipment fixed costs have been amortized. The figure shows that total annual costs are estimated to be $120 million in the first year the new engine standards apply, increasing to a peak of $1.7 billion in 2036 as increasing numbers of engines become subject to the new standards and an ever increasing amount of fuel is consumed. The net present value of the annualized costs over the period from 2007 to 2036 is $20.7 billion.

FIGURE V.D-2 -- ANNUAL COSTS OF THE PROPOSED TWO-STEP FUEL AND ENGINE PROGRAM



4. Cost per Ton of Emissions Reduced for the Total Program

We have calculated the cost per ton of emissions reduced associated with the proposed engine and fuel program. We have done this using the net present value of the annualized costs of the program through 2036 and the net present value of the annual emission reductions through 2036. We have also calculated the cost per ton of emissions in the year 2036 using the annual costs and emission reductions in that year alone. This number represents the long-term cost per ton of emissions reduced after all fixed costs of the program have been recovered by industry leaving only the variable costs of control. The cost per ton numbers include costs and emission reductions that would occur from the existing fleet (i.e., those pieces of nonroad equipment that were sold into the market prior to the proposed emission standards). These results are shown in Table V.D-2. We did the cost analysis using a 3% discount rate. We will also be conducting a similar analysis using a 7% discount rate and including this information in the docket.

TABLE V.D-2 -- TOTAL PROPOSED FUEL AND ENGINE PROGRAM AGGREGATE COST PER TON AND LONG-TERM ANNUAL COST PER TON ($2001)

Pollutant	2004-2036 Discounted Lifetime Cost per ton	Long-Term Cost per Ton in 2036
NOx+NMHC	$810	$530
PM	$8,700	$6,900
SO_x	$200[a]	$170

Notes:
[a] This result does not match that in Table 8.4-2 because the nonroad portion of the fuel is reduced to 15 ppm and does not stay at 500 (locomotive and marine portions are kept at 500ppm). The costs to reduce fuel sulfur from uncontrolled to 15ppm were assigned 50/50 to NOx+NMHC and PM for the reduction to 15 ppm is to enable aftertreatment technology.

5. Comparison With Other Means of Reducing Emissions

In comparison with other programs to control these pollutants, we believe that the proposed programs represent a cost effective strategy for generating substantial NOx+NMHC, PM, and SO2 reductions. This can be seen by comparing the 2007 fuel program (i.e., a sulfur cap of 500 ppm) cost per ton and the total program cost per ton with a number of standards that EPA has adopted in the past. Table V.D-3 summarizes the cost per ton of several past EPA actions for NOx+NMHC. Table V.D-4 summarizes the cost per ton of several past EPA actions for PM.

TABLE V.D-3 -- COST PER TON OF PREVIOUS MOBILE SOURCE PROGRAMS FOR NOX + NMHC

Program	*$/ton*
Tier 2 Nonroad Diesel	630
Tier 3 Nonroad Diesel	430
Tier 2 vehicle/gasoline sulfur	1,410 - 2,370
2007 Highway HD	2,260
2004 Highway HD	220 - 430
Off-highway diesel engine	450 - 710
Tier 1 vehicle	2,160 - 2,930
NLEV	2030
Marine SI engines	1,230 - 1,940
On-board diagnostics	2,430
Marine CI engines	30 - 190

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

TABLE V.D-4 -- COST PER TON OF PREVIOUS MOBILE SOURCE PROGRAMS FOR PM

Program	*$/ton*
Tier 1/Tier 2 Nonroad Diesel	2,410
2007 Highway HD	14,280
Marine CI engines	5,480 -4,070
1996 urban bus	12,870 - 20,590
Urban bus retrofit/rebuild	31,740
1994 highway HD diesel	21,930 - 25,670

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

To compare the cost per ton of SO_2 emissions reduced, we looked at the cost per ton for the Title IV SO_2 trading programs. This information is found in EPA report 430/R-02-004, “Documentation of EPA Modeling Applications (V.2.1) Using the Integrated Planning Model”, in Figure 9.11 on page 9-14 (www.epa.gov/airmarkets/epa-ipm/index.html#documentation). The SO_2 cost per ton results of the proposed program presented in Table V.D-2 compare very favorably with the program shown in Table V.D-5.

TABLE V.D-5 -- COST PER TON OF SO_2 FROM EPA BASE CASE 2000 FOR THE TITLE IV SO_2 TRADING PROGRAMS

Program	$/ton
Title IV SO_2 Trading Programs	$490 in 2010 to $610 in 2020

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

E. Do the Benefits Outweigh the Costs of the Standards?

Our analysis of the health and welfare benefits to be expected from this proposal are presented in this section. Briefly, the analysis projects major benefits throughout the period from initial implementation of the rule through 2030, the last year analyzed. As described below, thousands of deaths and other serious health effects would be prevented, yielding a net present value in 2004 of those benefits we could monetize of approximately $550 billion dollars. These benefits exceed the net present value of the social cost of the proposal ($17 billion) by a factor of over 30 to one.

1. What were the results of the benefit-cost analysis?

Table V.E-1 presents the primary estimate of reduced incidence of PM-related health effects for the years 2020 and 2030. In interpreting the results, it is important to keep in mind the limited set of effects we are able to monetize. Specifically, the table lists the PM-related benefits associated with the reduction of several health effects.[290] In 2030, we estimate that there will be 9,600 fewer fatalities per year associated with fine PM, and the rule will result in about 5,700 fewer cases of chronic bronchitis, 8,300 fewer hospitalizations (for respiratory and cardiovascular disease combined), and result in significant reductions in days of restricted activity due to respiratory illness (with an estimated 5.7 million fewer cases). We also estimate substantial health

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[290] Based upon recent preliminary findings by the Health Effects Institute, the concentration-response functions used to estimate reductions in hospital admissions may over- or underestimate the true concentration-response relationship. See Letter from Dan Greenberg, President, Health Effects Institute, May 30, 2002, attached to letter from Dr. Hopke, dated August 8, 2002. Docket A-2000-01, Document IV-A-145.

improvements for children from reduced upper and lower respiratory illness, acute bronchitis, and asthma attacks.[291]

Table V.E-2 presents the total monetized benefits for the years 2020 and 2030. This table also indicates with a "B" those additional health and environmental effects which we were unable to quantify or monetize. These effects are additive to estimate of total benefits, and EPA believes there is considerable value to the public of the benefits that could not be monetized. A full listing of the benefit categories that could not be quantified or monetized in our estimate are provided in Table V.E-5.

In summary, EPA's primary estimate of the benefits of the rule are approximately $81 + B billion in 2030. In 2020, total monetized benefits are approximately $43 + B billion. These estimates account for growth in real gross domestic product (GDP) per capita between the present and the years 2020 and 2030. As the table indicates, total benefits are driven primarily by the reduction in premature fatalities each year, which account for over 90 percent of total benefits.

[291] Our estimate incorporates significant reductions of 150,000 fewer cases of lower respiratory symptoms in children ages 7 to 14 each year, 110,000 fewer cases of upper respiratory symptoms (similar to cold symptoms) in asthmatic children each year, and 14,000 fewer cases of acute bronchitis in children ages 8 to 12 each year. In addition, we estimate that this rule will reduce almost 6,000 emergency room visits for asthma attacks in children each year from reduced exposure to particles. Additional incidents would be avoided from reduced ozone exposures. Asthma is the most prevalent chronic disease among children and currently affects over seven percent of children under 18 years of age.

TABLE V.E-1 -- REDUCTIONS IN INCIDENCE OF PM-RELATED ADVERSE HEALTH EFFECTS ASSOCIATED WITH THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

Endpoint	Avoided Incidence[a] (cases/year)	
	2020	2030
Premature mortality[b] - Base estimate: Long-term exposure (adults, 30 and over)	5,200	9,600
Chronic bronchitis (adults, 26 and over)	3,600	5,700
Non-fatal myocardial infarctions (adults, 18 and older)	9,200	16,000
Hospital admissions – Respiratory (adults, 20 and older)[c]	2,400	4,500
Hospital admissions – Cardiovascular (adults, 20 and older)[d]	1,900	3,800
Emergency Room Visits for Asthma (18 and younger)	3,600	5,700
Acute bronchitis (children, 8-12)	8,400	14,000
Lower respiratory symptoms (children, 7-14)	92,000	150,000
Upper respiratory symptoms (asthmatic children, 9-11)	77,000	110,000
Work loss days (adults, 18-65)	650,000	960,000
Minor restricted activity days (adults, age 18-65)	3,900,000	5,700,000

Notes:
[a] Incidences are rounded to two significant digits.
[b] Premature mortality associated with ozone is not separately included in this analysis
[c] Respiratory hospital admissions for PM includes admissions for COPD, pneumonia, and asthma.
[d] Cardiovascular hospital admissions for PM includes total cardiovascular and subcategories for ischemic heart disease, dysrhythmias, and heart failure.

TABLE V.E-2 -- EPA PRIMARY ESTIMATE OF THE ANNUAL QUANTIFIED AND MONETIZED BENEFITS ASSOCIATED WITH IMPROVED PM AIR QUALITY RESULTING FROM THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

Endpoint	Monetary Benefits[a,b] (millions 2000$, Adjusted for Income Growth)	
	2020	2030
Premature mortality[c] Long-term exposure, (adults, 30 and over)	$39,000	$74,000
Chronic bronchitis (WTP valuation; adults, 26 and over)	$1,600	$2,600
Non-fatal myocardial infarctions	$750	$1,300
Hospital Admissions from Respiratory Causes[d]	$38	$74
Hospital Admissions from Cardiovascular Causes[e]	$40	$80
Emergency Room Visits for Asthma	$1	$2
Acute bronchitis (children, 8-12)	$3	$5
Lower respiratory symptoms (children, 7-14)	$2	$3
Upper respiratory symptoms (asthmatic children, 9-11)	$2	$3
Work loss days (adults, 18-65)	$90	$130
Minor restricted activity days (adults, age 18-65)	$210	$320
Recreational visibility (86 Class I Areas)	$1,200	$1,900
Total Monetized Benefits[f]	$43,000 + B	$81,000 + B

Notes:
[a] Monetary benefits are rounded to two significant digits.
[b] Monetary benefits are adjusted to account for growth in real GDP per capita between 1990 and the analysis year (2020 or 2030).
[c] Valuation assumes the 5 year distributed lag structure described earlier. Results reflect the use of two different discount rates; a 3% rate which is recommended by EPA's Guidelines for Preparing Economic Analyses (US EPA, 2000a), and 7% which is recommended by OMB Circular A-94 (OMB, 1992).
[d] Respiratory hospital admissions for PM includes admissions for COPD, pneumonia, and asthma.
[e] Cardiovascular hospital admissions for PM includes total cardiovascular and subcategories for ischemic heart disease, dysrhythmias, and heart failure.
[f] B represents the monetary value of the unmonetized health and welfare benefits. A detailed listing of unquantified PM, ozone, CO, and NMHC related health effects is provided in Table V.E-5.

The estimated social cost (measured as changes in consumer and producer surplus) in 2030 to implement the final rule from Table V.F-2 is $1.5 billion (2000$). Thus, the net benefit (social benefits minus social costs) of the program at full implementation is approximately $79 + B billion. In 2020, partial implementation of the program yields net benefits of $42 + B billion. Therefore, implementation of the final rule is expected to provide society with a net gain in social welfare based on economic efficiency criteria. Table V.E-3 presents a summary of the benefits, costs, and net benefits of the proposed rule. Figure V-E.1 displays the stream of benefits, costs, and net benefits of the Nonroad Land-based Diesel Vehicle Rule from 2007 to 2030. In addition, Table V-E.4 presents the net present value of the stream of benefits, costs, and net benefits associated with the rule for this 23 year period (using a three percent discount rate). The total net present value in 2004 of the stream of net benefits (benefits minus costs) is $530 billion.

TABLE V.E-3 -- SUMMARY OF BENEFITS, COSTS, AND NET BENEFITS OF THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

	2020[a] (Billions of 2000 dollars)	2030 [a] (Billions of 2000 dollars)
Social Costs[b]	$1.4	$1.5
Social Benefits[b, c, d]:		
CO, VOC, Air Toxic-related benefits	Not monetized	Not monetized
Ozone-related benefits	Not monetized	Not monetized
PM-related Welfare benefits	$1.2	$1.9
PM-related Health benefits	$42+ B	$79 + B
Net Benefits (Benefits-Costs)[c]	$42 + B	$79 + B

Notes:
[a] All costs and benefits are rounded to two significant digits.
[b] Note that costs are the total costs of reducing all pollutants, including CO, VOCs and air toxics, as well as NOx and PM. Benefits in this table are associated only with PM, NOx and SO2 reductions.
[c] Not all possible benefits or disbenefits are quantified and monetized in this analysis. Potential benefit categories that have not been quantified and monetized are listed in Table V.E-5. B is the sum of all unquantified benefits and disbenefits.

FIGURE V.E-1 -- STREAM OF BENEFITS, COSTS, AND NET BENEFITS OF THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

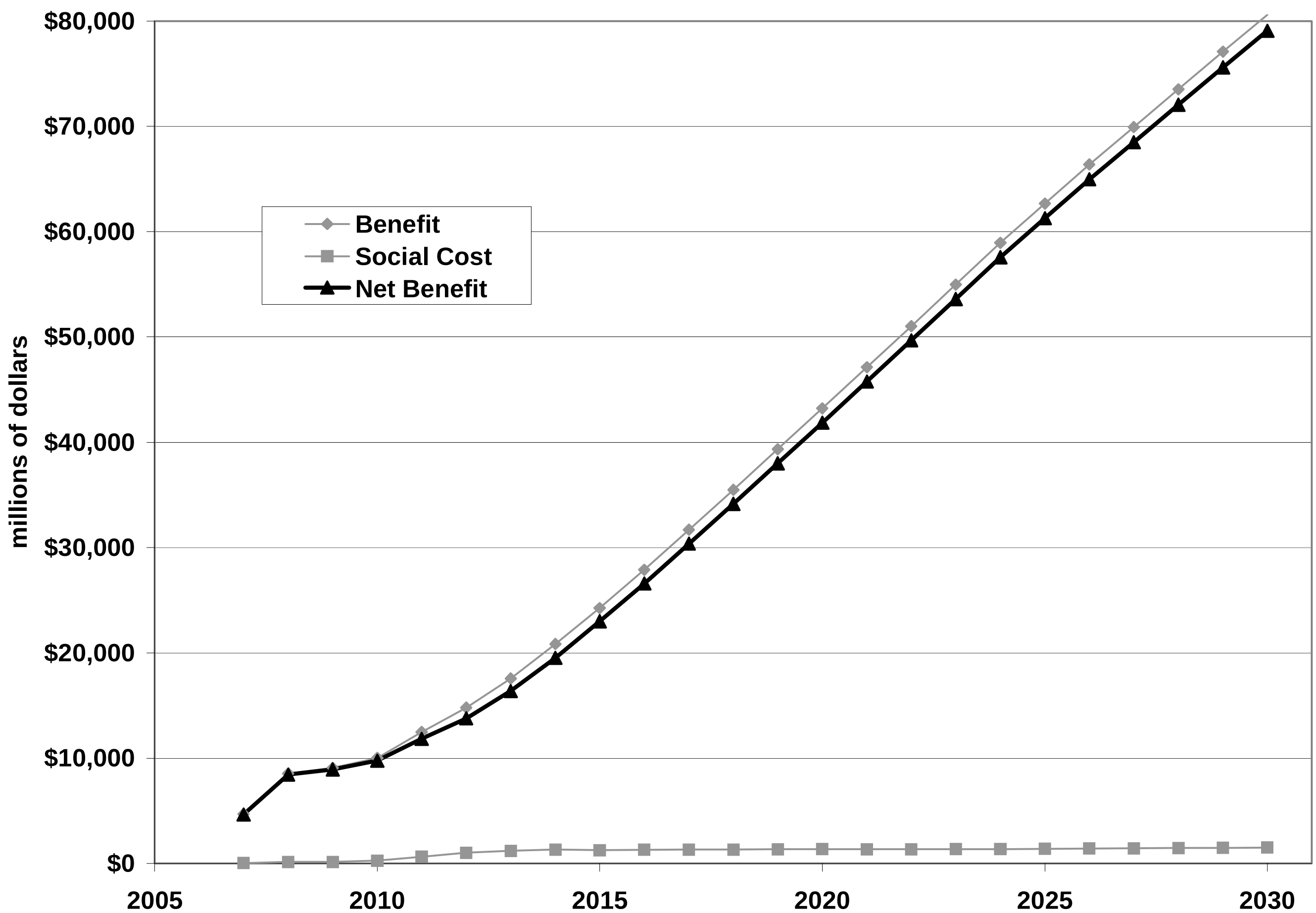

TABLE V.E-4 -- NET PRESENT VALUE IN 2004 OF THE STREAM OF BENEFITS, COSTS, AND NET BENEFITS FOR THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS (BILLIONS OF 2000$)

Social Costs	$17
Social Benefits	$550
Net Benefits	$530[a]

Notes:
[a] Numbers do not add due to rounding.

2. What was our overall approach to the benefit-cost analysis?

The basic question we sought to answer in the benefit-cost analysis was, ``What are the net yearly economic benefits to society of the reduction in mobile source emissions likely to be achieved by this proposed rulemaking?" In designing an analysis to address this question, we selected two future years for analysis (2020 and 2030) that are representative of the stream of benefits and costs at partial and full-implementation of the program.

To quantify benefits, we evaluated PM-related health effects (including directly emitted PM, SO2, and NOx contributions to fine particulate matter). Our approach requires the estimation of changes in air quality expected from the rule and then estimating the resulting impact on health. In order to characterize the benefits of today's action, given the constraints on time and resources available for the analysis, we adopted a benefits transfer technique that relies on air quality and benefits modeling for a preliminary control option for nonroad diesel engines and fuels. Results from the modeled preliminary control option in 2020 and 2030 are then scaled and transferred to the emission reductions expected from the proposed rule. We also transferred modeled results by using scaling factors associated with time to examine the stream of benefits in years other than 2020 and 2030.

More specifically, our health benefits assessment is conducted in two phases. Due to the time requirements for running the sophisticated emissions and air quality models needed to obtain estimates of the benefits expected to result from implementation of the rule, it is often necessary to select an example set of emission reductions to use for the purposes of emissions and air quality modeling. In phase one, we evaluate the PM and ozone related health effects associated with a modeled preliminary control option that was a close approximation of the proposed standards in the years 2020 and 2030. Using information from the modeled preliminary control option on the changes in ambient concentrations of PM and ozone, we then conduct a health assessment to estimate the number of reduced incidences of illnesses, hospitalizations, and premature fatalities associated with this scenario and estimate the total economic value of these health benefits. The standards we are proposing in this rulemaking, however, are slightly different in the amount of emission reductions expected to be achieved in 2020 and 2030 relative to the modeled scenario. Thus, in phase two of the analysis we apportion the results of the phase one analysis to the underlying NOx, SO2, and PM emission reductions and scale the apportioned benefits to reflect differences in emissions reductions between the modeled preliminary control option and the proposed standards. The sum of the scaled benefits for the PM, SO2, and NOx emission reductions provide us with the total benefits of the rule.

The benefit estimates derived from the modeled preliminary control option in phase one of our analysis uses an analytical structure and sequence similar to that used in the benefits analyses for the Heavy Duty Engine/Diesel Fuel final rule and in the "section 812 studies" to estimate the total benefits and costs of the full Clean Air Act.[292] We used many of the same models and assumptions used in the Heavy Duty Engine/Diesel Fuel analysis as well as other Regulatory Impact Analyses (RIAs) prepared by the Office of Air and Radiation. By adopting the major design elements, models, and assumptions developed for the section 812 studies and other RIAs, we have largely relied on methods which have already received extensive review by the independent Science Advisory Board (SAB), by the public, and by other federal agencies. In addition, we will be working through the next Section 812 study process to enhance our methods. [293] Interested parties will therefore be able to obtain further information from the section 812 study on the kinds of methods we are likely to use for estimating benefits and costs in the final nonroad diesel rule.

The benefits transfer method used in phase two of the analysis is similar to that used to estimate benefits in the recent analysis of the Nonroad Large Spark-Ignition Engines and Recreational Engines standards (67 FR 68241, November 8, 2002). A similar method has also been used in recent benefits analyses for the proposed Industrial Boilers and Process Heaters NESHAP and the Reciprocating Internal Combustion Engines NESHAP.

On September 26, 2002, the National Academy of Sciences (NAS) released a report on its review of the Agency's methodology for analyzing the health benefits of measures taken to reduce air pollution. The report focused on EPA's approach for estimating the health benefits of regulations designed to reduce concentrations of airborne particulate matter (PM).

In its report, the NAS said that EPA has generally used a reasonable framework for analyzing the health benefits of PM-control measures. It recommended, however, that the Agency take a number of steps to improve its benefits analysis. In particular, the NAS stated that the Agency should:

- include benefits estimates for a range of regulatory options;
- estimate benefits for intervals, such as every five years, rather than a single year;
- clearly state the projected baseline statistics used in estimating health benefits, including those for air emissions, air quality, and health outcomes;
- examine whether implementation of proposed regulations might cause unintended impacts on human health or the environment;
- when appropriate, use data from non-U.S. studies to broaden age ranges to which current estimates apply and to include more types of relevant health outcomes;
- begin to move the assessment of uncertainties from its ancillary analyses into its Base analyses by conducting probabilistic, multiple-source uncertainty analyses. This assessment should be based on available data and expert judgment.

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[292] The section 812 studies include: (1) US EPA, Report to Congress: The Benefits and Costs of the Clean Air Act, 1970 to 1990, October 1997 (also known as the ``Section 812 Retrospective Report''); and (2) the first in the ongoing series of prospective studies estimating the total costs and benefits of the Clean Air Act (see EPA report number: EPA-410-R-99-001, November 1999). See Docket A-99-06, Document II-A-21.

[293] We anticipate a public SAB meeting June 11-13, 2003, in Washington, DC, regarding components of our analytical blueprint. Interested parties may want to consult the webpage: http://www.epa.gov/science1.

Although the NAS made a number of recommendations for improvement in EPA's approach, it found that the studies selected by EPA for use in its benefits analysis were generally reasonable choices. In particular, the NAS agreed with EPA's decision to use cohort studies to derive benefits estimates. It also concluded that the Agency's selection of the American Cancer Society (ACS) study for the evaluation of PM-related premature mortality was reasonable, although it noted the publication of new cohort studies that should be evaluated by the Agency.

EPA has addressed many of the NAS comments in our analysis of the proposed rule. We provide benefits estimates for each year over the rule implementation period for a wide range of regulatory alternatives, in addition to our proposed emission control program. We use the estimated time path of benefits and costs to calculate the net present value of benefits of the rule. In the RIA, we provide baseline statistics for air emissions, air quality, population, and health outcomes. We have examined how our benefits estimates might be impacted by expanding the age ranges to which epidemiological studies are applied, and we have added several new health endpoints, including non-fatal heart attacks, which are supported by both U.S. studies and studies conducted in Europe. We have also improved the documentation of our methods and provided additional details about model assumptions.

Several of the NAS recommendations addressed the issue of uncertainty and how the Agency can better analyze and communicate the uncertainties associated with its benefits assessments. In particular, the Committee expressed concern about the Agency's reliance on a single value from its analysis and suggested that EPA develop a probabilistic approach for analyzing the health benefits of proposed regulatory actions. The Agency agrees with this suggestion and is working to develop such an approach for use in future rulemakings. EPA plans to hold a meeting of its Science Advisory Board (SAB) in early Summer 2003 to review its plans for addressing uncertainty in its analyses. Our likely approach will incorporate short-term elements intended to provide interim methods in time for the final Nonroad rule to address uncertainty in important analytical parameters such as the concentration-response relationship for PM-related premature mortality. Our approach will also include longer-term elements intended to provide scientifically sound, peer-reviewed characterizations of the uncertainty surrounding a broader set of analytical parameters and assumptions, including but not limited to emissions and air quality modeling, demographic projections, population health status, concentration-response functions, and valuation estimates.

3. What are the significant limitations of the benefit-cost analysis?

Every benefit-cost analysis examining the potential effects of a change in environmental protection requirements is limited to some extent by data gaps, limitations in model capabilities (such as geographic coverage), and uncertainties in the underlying scientific and economic studies used to configure the benefit and cost models. Deficiencies in the scientific literature often result in the inability to estimate quantitative changes in health and environmental effects, such as potential increases in premature mortality associated with increased exposure to carbon monoxide. Deficiencies in the economics literature often result in the inability to assign economic values even to those health and environmental outcomes which can be quantified. While these general uncertainties in the underlying scientific and economics literatures, which can cause the valuations to be higher or lower, are discussed in detail in the Regulatory Support Document and its supporting documents and references, the key uncertainties which have a bearing on the results of the benefit-cost analysis of this final rule include the following:

- The exclusion of potentially significant benefit categories (such as health and ecological benefits of reduction in CO, VOCs, air toxics, and ozone);

- Errors in measurement and projection for variables such as population growth;

- Uncertainties in the estimation of future year emissions inventories and air quality;

- Uncertainties associated with the scaling of the results of the modeled benefits analysis to the proposed standards, especially regarding the assumption of similarity in geographic distribution between emissions and human populations and years of analysis;

- Variability in the estimated relationships of health and welfare effects to changes in pollutant concentrations;

- Uncertainties in exposure estimation;

- Uncertainties associated with the effect of potential future actions to limit emissions.

Despite these uncertainties, we believe the benefit-cost analysis provides a reasonable indication of the expected economic benefits of the proposed rulemaking in future years under a set of assumptions.

One significant limitation to the benefit transfer method applied in this analysis is the inability to scale ozone-related benefits. Because ozone is a homogeneous gaseous pollutant, it is not possible to apportion ozone benefits to the precursor emissions of NOx and VOC. Coupled with the potential for NOx reductions to either increase or decrease ambient ozone levels, this prevents us from scaling the benefits associated with a particular combination of VOC and NOx emissions reductions to another. Because of our inability to scale ozone benefits, we do not include ozone benefits as part of the monetized benefits of the proposed standards. For the most part, ozone benefits contribute substantially less to the monetized benefits than do benefits from PM, thus their omission will not materially affect the conclusions of the benefits analysis. Although we expect economic benefits to exist, we were unable to quantify or to value specific changes in ozone, CO or air toxics because we did not perform additional air quality modeling.

There are also a number of health and environmental effects which we were unable to quantify or monetize. A full appreciation of the overall economic consequences of the proposed rule requires consideration of all benefits and costs expected to result from the new standards, not just those benefits and costs which could be expressed here in dollar terms. A complete listing of the benefit categories that could not be quantified or monetized in our estimate are provided in Table V.E-5. These effects are denoted by “B” in Table V.E-3 above, and are additive to the estimates of benefits.

TABLE V.E-5 -- ADDITIONAL, NON-MONETIZED BENEFITS OF THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

Pollutant	Unquantified Effects
Ozone Health	Premature mortality[a] Increased airway responsiveness to stimuli Inflammation in the lung Chronic respiratory damage Premature aging of the lungs Acute inflammation and respiratory cell damage Increased susceptibility to respiratory infection Non-asthma respiratory emergency room visits Increased school absence rates
Ozone Welfare	Decreased yields for commercial forests (for example, Western US) Decreased yields for fruits and vegetables Decreased yields for non-commercial crops Damage to urban ornamental plants Impacts on recreational demand from damaged forest aesthetics Damage to ecosystem functions
PM Health	Infant mortality Low birth weight Changes in pulmonary function Chronic respiratory diseases other than chronic bronchitis Morphological changes Altered host defense mechanisms Cancer Non-asthma respiratory emergency room visits
PM Welfare	Visibility in many Class I areas Residential and recreational visibility in non-Class I areas Soiling and materials damage Damage to ecosystem functions
Nitrogen and Sulfate Deposition Welfare	Impacts of acidic sulfate and nitrate deposition on commercial forests Impacts of acidic deposition to commercial freshwater fishing Impacts of acidic deposition to recreation in terrestrial ecosystems Reduced existence values for currently healthy ecosystems Impacts of nitrogen deposition on commercial fishing, agriculture, and forests Impacts of nitrogen deposition on recreation in estuarine ecosystems Damage to ecosystem functions
CO Health	Premature mortality[a] Behavioral effects
HC Health[b]	Cancer (benzene, 1,3-butadiene, formaldehyde, acetaldehyde)

Pollutant	Unquantified Effects
HC Welfare	Direct toxic effects to animals Bioaccumulation in the food chain Damage to ecosystem function Odor

Notes:
[a] Premature mortality associated with ozone and carbon monoxide is not separately included in this analysis. In this analysis, we assume that the ACS/Krewski, et al. C-R function for premature mortality captures both PM mortality benefits and any mortality benefits associated with other air pollutants. A copy of Krewski, et a., can be found in Docket A-99-06, Document No. IV-G-75.
[b] Many of the key hydrocarbons related to this rule are also hazardous air pollutants listed in the Clean Air Act.

F. Economic Impact Analysis

An Economic Impact Analysis (EIA) was prepared to estimate the economic impacts of this proposal on producers and consumers of nonroad engines and equipment and related industries. The Nonroad Diesel Economic Impact Model (NDEIM), developed for this analysis, was used to estimate market-level changes in price and outputs for affected engine, equipment, fuel, and application markets as well as the social costs and their distribution across economic sectors affected by the program. This section presents the results of the economic impact analysis. A detailed description of the NDEIM, the model inputs, and several sensitivity analyses can be found in Chapter 10 of the Draft Regulatory Impact Analysis prepared for this proposal.

1. What is an Economic Impact Analysis?

Regulatory agencies conduct economic impact analyses of potential regulatory actions to inform decision makers about the effects of a proposed regulation on society's current and future well-being. In addition to informing decision makers within the Agency, economic impact analyses are conducted to meet the statutory and administrative requirements imposed by Congress and the Executive office. The Clean Air Act requires an economic impact analysis under Section 317, while Executive Order 12866–Regulatory Planning and Review requires Executive Branch agencies to perform benefit-costs analysis of all rules it deems to be "significant" (typically over $100 million annual social costs) and submit these analysis to the Office of Management and Budget (OMB) for review. This economic impact analysis estimates the potential market impacts of the proposed rule's compliance costs and provides the associated social costs and their distribution across stakeholders for comparison with social benefits (as presented in Section V.E).

2. What is EPA's Economic Analysis Approach for this Proposal?

The underlying objective of an EIA is to evaluate the effect of a proposed regulation on the welfare of affected stakeholders and society in general. Using information on the expected compliance costs of the proposed program as presented in the preceding discussion, this EIA explores how the companies that produce nonroad diesel engines, equipment, or fuel may change their production behavior in response to the costs of complying with the standards. It also explores how the consumers who use the affected products may change their purchasing decisions. For example, the construction industry may reduce purchases if the prices of nonroad diesel equipment increase, thereby reducing the volume of equipment sold (or market demand) for such equipment. Alternatively, the construction industry may pass along these additional costs to the consumers of their final goods and services by increasing prices, which would mitigate the potential impacts on the purchases of nonroad diesel equipment.

The conceptual approach of the NDEIM is to link significantly affected markets to mimic how compliance costs will potentially ripple through the economy. The compliance costs will be directly borne by engine manufacturers, equipment manufacturers, and petroleum refineries. Depending on market characteristics, some or all of these compliance costs will be passed on through the supply chain in the form of higher prices extending to producers and consumers in the application markets (i.e., construction, agriculture, and manufacturing). The NDEIM explicitly models these linkages and estimates behavioral responses that lead to new equilibrium prices and output for all related markets and the resulting distribution of costs across stakeholders.

The NDEIM uses a multi-market partial equilibrium approach to track changes in price and quantity for 60 integrated product markets, as follows:

- 7 diesel engine markets (less than 25 hp, 26 to 50 hp, 51 to 75 hp, 76 to 100 hp, 101 to 175 hp, 176 to 600 hp, and greater than 600 hp; the EIA includes more horsepower categories than the standards, allowing more efficient use of the engine compliance cost estimates developed for this proposal.)
- 42 diesel equipment markets (7 horsepower categories within 7 application categories: agricultural, construction, general industrial, pumps and compressors, generator and welder sets, refrigeration and air conditioning, and lawn and garden; there are 7 horsepower/application categories that did not have sales in 2000 and are not included in the model, so the total number of diesel equipment markets is 42 rather than 49)
- 3 application markets (agricultural, construction, and manufacturing)
- 8 nonroad diesel fuel markets (2 sulfur content levels of 15 ppm and 500 ppm for each of 4 PADDs; PADDs 1 and 3 are combined for the purpose of this analysis). It should be noted that PADD 5 includes Alaska and Hawaii. Because those two states are geographically separate from the rest of PADD 5, we seek comment on whether they should be considered as separate fuel markets.

The NDEIM uses an intermediate run time frame and assumes perfect competition in the market sectors. It is a computer model comprised of a series of spreadsheet modules that define the baseline characteristics of the supply and demand for the relevant markets and the relationships between them. A detailed description of the model methodology, inputs, and parameters is provided in Chapter 10 of the draft RIA prepared for this proposal. The model methodology is firmly rooted in applied microeconomic theory and was developed following the *OAQPS Economic Analysis Resource Document*.[294] Based on the specified market linkages, the model is shocked by applying the engineering compliance cost estimates to the appropriate market suppliers and then numerically solved using an iterative auctioneer approach by "calling out" new prices until a new equilibrium is reached in all markets simultaneously.

The actual economic impacts of the proposed rule will be determined by the ways in which producers and consumers of the engines, equipment, and fuels affected by the proposal change their behavior in response to the costs incurred in complying with the standards. In the NDEIM, these behaviors are modeled by the demand and supply elasticities. The supply elasticities for the engine and equipment markets and the demand elasticities for the application markets were estimated using econometric methods. The procedures and results are reported in Appendix 10.1 of the draft RIA. Literature-based estimates were used for the supply elasticities in the application and fuel markets.

There are two ways to handle the demand elasticities for the engine, equipment, and fuel markets. In the approach used in NDEIM, these demand elasticities are internally derived based on the specified market linkages, i.e., the demand for engines, equipment, and fuel are modeled as directly related to the supply and demand of goods and services supplied by the final application markets. In other words, the supply of those goods and services determines the demand for equipment and fuel, and the supply of equipment determines the demand for engines. Using this approach, the NDEIM predicts that engine and equipment production will decrease by only a small amount: 0.013% and 0.014% respectively (see Table V.F-1). Also, please see draft RIA Appendices 10A and 10B for more detailed estimates on the price increase estimates. Because the application markets are modeled with inelastic or unit elastic demand and supply elasticities (quantity supplied/demanded is expected to be fairly insensitive to price changes or they will vary directly with price changes), the model predicts that engine and equipment manufacturers will pass along virtually all of their costs to end users.

An alternative approach could be used in which the demand elasticities for the equipment, engine, and fuel markets are not derived as part of the model. They could be estimated separately or a sensitivity analysis could be conducted that assumes more elastic values than those generated by the NDEIM. We are continuing to investigate this matter and will be placing additional information about elasticities in the docket during the comment period for this rule. We request comment on that information as well as on the methodology and other aspects of this EIA.

The estimated engine and equipment market impacts are based solely on the expected increase in variable costs associated with the proposed standards. Fixed costs associated with the engine emission standards are not included in the market analysis reported in Table IV-F-1. This is because in an analysis of competitive markets the industry supply curve is based on its marginal

[294] US Environmental Protection Agency, Office of Air Quality Planning and Standards, Innovative Strategies and Economics Group, *OAQPS Economic Analysis Resource Document*, April 1999. A copy of this document can be found in Docket A-2001-28, Document No. II-A-14.

cost curve, and fixed costs are not reflected in changes in the marginal cost curve. In addition, fixed costs are primarily R&D costs associated with design and engineering changes, and firms in the affected industries currently allocate funds for these costs. Therefore, fixed costs are not likely to affect the prices of engines or equipment. This assumption is described in greater detail in Section 10.2 of the draft RIA. R&D costs are a long-run concern and decisions to invest or not invest in R&D are made in the long run. If funds have to be diverted from some other activity into R&D needed to meet the environmental regulations, then these costs represent a component of the social costs of the rule. Therefore, fixed costs are included in the welfare impact estimates reported in Table V.F-2 as additional costs on producers. We also performed a sensitivity analysis, included in Chapter 10 of the draft RIA for this proposal, that includes fixed costs as part of the model. This results in a transfer of welfare losses from engine and equipment markets to the application markets, but does not change the overall welfare losses associated with the proposal.

Economic theory indicates that, in the long run, prices are expected to reflect the average total costs of the marginal producer in a market and not just variable costs. This suggests that it may be necessary to treat fixed costs differently for a long-run analysis. We will continue to investigate this effect and intend to place additional informationin the docket during the comment period for this rule. We request comment on that information as well as on how fixed costs and R&D expenditures are handled in the NDEIM.

In addition to the variable and fixed costs described above, there are three additional costs components that are included in the total social cost estimates of the proposed regulation but that are not explicitly included in the NDEIM. These are operating savings (costs), fuel marker costs, and spillover from 15 ppm fuel to higher sulfur fuel. We request comment on how best to incorporate each of these costs in the analysis.

Operating savings (costs) refers to changes in operating costs that are expected to be realized by users of both existing and new nonroad diesel equipment as a result of the reduced sulfur content of nonroad diesel fuel. These include operating savings (cost reductions) due to fewer oil changes, which accrue to nonroad engines, and marine and locomotive engines, that are already in use as well as new nonroad engines that will comply with the proposed standards (see Section V.B.). These savings (costs) also include any extra operating costs associated with the new PM emission control technology which may accrue to new engines that use this new technology. These savings (costs) are not included directly in the model because some of the savings accrue to existing engines and because these savings (costs) are not expected to affect consumer decisions with respect to new engines. Instead, they are added into the estimated welfare impacts as additional costs to the application markets, since it is the users of these engines that will see these savings (costs). Nevertheless, a sensitivity analysis was also performed in which these savings (costs) are included as inputs to the NDEIM, where they are modeled as benefits accruing to the application producers. The results of this analysis are presented in Chapter 10 of the draft RIA.

Fuel marker costs refers to costs associated with marking high sulfur diesel fuel in the locomotive, marine, and heating oil markets between 2007 and 2014. Marker costs are not included in the market analysis because locomotive, marine, and heating oil markets are not explicitly modeled in the NDEIM. Similar to the operating savings (costs), marker costs are added into the estimated welfare impacts separately.

The costs of fuel that spills over from the 15 ppm market to higher grade sulfur fuel are also not included in the NDEIM but, instead, are added into the estimated welfare impacts separately. As described in Section IV above, refiners are expected to produce more 15 ppm fuel than is required for the nonroad diesel fuel market. This excess 15 ppm fuel will be sold into markets that allow fuel with a higher sulfur level (e.g., locomotive, marine diesel, or home heating fuel). Because this spillover fuel will meet the 15 ppm limit, it is necessary to count the costs of sulfur reduction processes against those fuels.

Consistent with the engine and equipment cost discussion in Section V.C. of this preamble, the EIA does not include any cost savings associated with the proposed equipment transition flexibility program or the proposed nonroad engine ABT program. As a result, the results of this EIA can be viewed as somewhat conservative, in this respect.

3. What Are the Results of this Analysis?

The economic analysis consists of two parts: a market analysis and welfare analysis. The market analysis looks at expected changes in prices and quantities for directly and indirectly affected market commodities. The welfare analysis looks at economic impacts in terms of annual and present value changes in social costs. For this proposed rule, the social costs are computed as the sum of market surplus offset by operating cost savings. Market surplus is equal to the aggregate change in consumer and producer surplus based on the estimated market impacts associated with the proposed rule. Operating cost savings are associated with the decreased sulfur content of diesel fuel. These include maintenance savings (cost reductions) and changes in fuel efficiency. Increased maintenance costs may also be incurred for some technologies. Operating costs are not included in the market analysis but are instead listed as a separate category in the social cost results tables.

Economic impact results for 2013, 2020, and 2030 are presented in this section. The first of these years, 2013, corresponds to the first year in which the standards affect all engines, equipment, and fuels. It should be noted that, as illustrated in Table V.D-2, above, aggregate program costs peak in 2014; increases in costs after that year are due to increases in the population of engines over time. The other years, 2020 and 2030, correspond to years analyzed in our benefits analysis. Detailed results for all years are included in Appendix 10.E. for this chapter.

a. Expected Market Impacts

The market impacts of this rule suggest that the overall economic impact of the proposed emission control program on society is expected be small, on average. According to this analysis, the average prices of goods and services produced using equipment and fuel affected by the proposal are expected to increase by about 0.02 percent. The estimated price increases and quantity reductions for engines and equipment vary depending on compliance costs. In general, we would expect for price increases to be higher (lower) as a result of a high (low) relative level of compliance costs to market price. We would also expect the change in price to be highest when compliance costs are highest.

The estimated market impacts for 2013, 2020, and 2030 are presented in Table V.F-1. The market-level impacts presented in this table represent production-weighted averages of the individual market-level impact estimates generated by the model: the average expected price increase and quantity decrease across all of the units in each of the engine, equipment, fuel, and final application markets. For example, the model includes seven individual engine markets that reflect the different horsepower size categories. The 23 percent price change for engines shown in Table V.F-1 for 2013 is an average price change across all engine markets weighted by the number of production units. Similarly, equipment impacts presented in Table V.F-1 are weighted averages of 42 equipment-application markets, such as small (< 25hp) agricultural equipment and large (>600hp) industrial equipment. It should be noted that price increases and quantity decreases for specific types of engines, equipment, application sectors, or diesel fuel markets are likely to be different. But the data in this table provide a broad overview of the expected market impacts that is useful when considering the impacts of the proposal on the economy as a whole. The individual market-level impacts are presented in Chapter 10 of the draft RIA for this proposal.

Engine Market Results: Most of the variable costs associated with the proposed rule are passed along in the form of higher prices. The average price increase in 2013 for engines is estimated to be about 23 percent. This percentage is expected to decrease to about 19.5 percent for 2020 and later. This expected price increase varies by engine size because compliance costs are a larger share of total production costs for smaller engines. In 2013, the year of greatest compliance costs overall, the largest expected percent price increase is for engines between 25 and 50 hp: 34 percent or $852; the average price for an engine in this category is about $2,500. However, this price increase is expected to drop to 26 percent, or about $647, for 2016 and later. The smallest expected percent price increase in 2013 is for engines in the greater than 600 hp category. These engines are expected to see price increases of about 3 percent increase in 2013, increasing to about 5.6 percent in 2014 and beyond. The expected price increase for these engines is about $4,211 in 2013, increasing to about $6,950 in 2014 and later, for engines that cost on average about $125,000.

The market impact model predicts that even with these increase in engine prices, total demand is not expected to change very much. The expected average change in quantity is only about 69 engines per year in 2013, out of total sales of more than 500,000 engines. The estimated change in market quantity is small because as compliance costs are passed along the supply chain they become a smaller share of total production costs. In other words, firms that use these engines and equipment will continue to purchase them even at the higher cost because the increase in costs will not have a large impact on their total production costs. Diesel equipment is only one factor of production for their output of construction, agricultural, or manufactured goods. The average decrease in the quantity of all engines produced as a result of the regulation is estimated to be about 0.013 percent. This decrease ranges from 0.010 percent for engines less than 25 hp to 0.016 percent for engines 175 to 600 hp.

Equipment Market Results: Estimated price changes for the equipment markets reflect both the direct costs of the proposed standards on equipment production and the indirect cost through increased engine prices. In 2013, the average price increase for nonroad diesel equipment is estimated to be about 5.2 percent. This percentage is expected to decrease to about 4.5 percent for 2020 and beyond. The range of estimated price increases across equipment types parallels the share of engine costs relative to total equipment price, so the estimated percentage price increase among equipment types also varies. The market price in 2013 for agricultural equipment between 175 and 600 hp is estimated to increase about 1.4 percent, or $1,835 for equipment with an average cost of $130,000. This compares with an estimated engine price increase of about $1,754 for engines of that size. The largest expected price increase in 2013 for equipment is $4,335, or 4.9 percent, for pumps and compressors over 600 hp. This compares with an estimated engine price increase of about $4,211 for engines of that size. The smallest expected price increase in 2013 for equipment is $125, or 3.6 percent, for construction equipment less than 25 hp. This compares with an estimated engine price increase of about $124 for engines of that size. The price changes for the equipment are less than that for engines because the engine is only one input in the production of equipment.

The output reduction for nonroad diesel equipment is estimated to be very small and to average about 0.014 percent for all years. This decrease ranges from 0.005 percent for general manufacturing equipment to 0.019 percent for construction equipment. The largest expected decrease in quantity in 2013 is 13 units of construction equipment per year for construction equipment between 100 and 175 hp, out of about 62,800 units. The smallest expected decrease in quantity in 2013 is less than one unit per year in all hp categories of pumps and compressors.

TABLE V.F-1 -- SUMMARY OF MARKET IMPACTS ($2001)

Market	Engineering Cost	Change in Price		Change in Quantity	
	Per Unit	Absolute ($million)	Percent	Absolute	Percent
2013					
Engines	$1,087	$840	22.9	–69[a]	–0.013
Equipment	$1,021	$1,017	5.2	–118	–0.014
Application Markets[b]			0.02		–0.010
No. 2 Distillate Nonroad	$0.039	$0.038	4.1	–1.38[c]	–0.013
2020					
Engines	$1,028	$779	19.5	–79[a]	–0.013
Equipment	$1,018	$1,013	4.4	–135	–0.014
Application Markets[b]			0.02		–0.010
No. 2 Distillate Nonroad	$0.039	$0.039	4.1	–1.58[c]	–0.014
2030					
Engines	$1,027	$768	19.4	–92[a]	–0.013
Equipment	$1,004	$999	4.5	–156	–0.014
Application Markets[b]			0.02		–0.010
No. 2 Distillate Nonroad	$0.039	$0.039	4.1	–1.84[c]	–0.014

Notes:
[a] The absolute change in the quantity of engines represents only engines sold on the market. Reductions in engines consumed internally by integrated engine/equipment manufacturers are not reflected in this number but are captured in the cost analysis. For this reason, the absolute change in the number of engines and equipment does not match.
[b] The model uses normalized commodities in the application markets because of the great heterogeneity of products. Thus, only percentage changes are presented.
[c] Units are in million of gallons.

Application Market Results: The estimated price increase associated with the proposed standards in all three of the application markets is very small and averages about 0.02 percent for all years. In other words, on average, the prices of goods and services produced using the engines, equipment, and fuel affected by this proposal are expected to increase only negligibly. This is because in all of the application markets the compliance costs passed on through price increases represent a very small share of total production costs. For example, the construction industry realizes an increase in production costs of approximately $468 million in 2013 because of the price increases for diesel equipment and fuel. However, this represents only 0.03 percent of the

$1,392 billion value of shipments in the construction industry in 2001. The estimated average commodity price increase in 2013 ranges from 0.06 percent in the agricultural application market to about 0.01 percent in the manufacturing application market. The percentage change in output is also estimated to be very small and averages about 0.01 percent. This reduction ranges from less than a 0.01 percent decrease in manufacturing to about a 0.02 percent decrease in construction. Note that these estimated price increases and quantity decreases are average for these sectors and may vary for specific subsectors. Also, note that absolute changes in price and quantity are not provided for the application markets in Table V.F-1 because normalized commodity values are used in the market model. Because of the great heterogeneity of manufactured or agriculture products, a normalized commodity ($1 unit) is used in the application markets. This has no impact on the estimated percentage change impacts but makes interpretation of the absolute changes less informative.

Fuel Markets Results: The estimated average price increase across all nonroad diesel fuel is about 4 percent for all years. For 15 ppm fuel, the estimated price increase for 2013 ranges from 3.2 percent in the East Coast region (PADD 1&3) to 9.3 percent in the mountain region (PADD 4). The average national output decrease for all fuel is estimated to be about 0.01 percent for all years, and is relatively constant across all four regional fuel markets.

b. Expected Welfare Impacts

Social cost impact estimates are presented in Table V.F-2. A time series of social costs from 2007 through 2030 is presented in Table IV.F-3. As described above, the total social cost of the regulation is the sum of the changes in producer and consumer surplus estimated by the model plus engine maintenance savings (negative costs) resulting from using fuel with a lower sulfur content. Total social costs in 2013 are projected to be 1,202.4 million ($2001). About 82 percent of the total social costs is expected to be borne by producers and consumers in the application markets, indicating that the majority of the costs are expected to be passed on in the form of higher prices. When these estimated impacts are broken down, 58 percent are expected to be borne by consumers in the application markets and 42 percent are expected to be borne by producers in the application markets. Equipment manufacturers are expected to bear about 10 percent of the total social costs. Engine manufacturers and diesel fuel refineries are expected to bear 2.5 percent and 0.5 percent, respectively. The remaining 5.0 percent is accounted for by fuel marker costs and the additional costs of 15 ppm fuel being sold in to markets such as marine diesel, locomotive, and home heating fuel that do not require it.

In 2030, the total social costs are projected to be about $1,509.6 million ($2001). The increase is due to the projected annual growth in the engine and equipment populations. As in earlier years, producers and consumers in the application markets are expected to bear the large majority of the costs, approximately 94 percent. This is consistent with economic theory, which states that, in the long run, all costs are passed on to the consumers of goods and services.

The present value of total social costs through 2030 is estimated to be $16.5 billion ($2001). This present value is calculated using a social discount rate of 3 percent from 2004 through 2030. We also performed an analysis using an alternative 7 percent social discount rates.

Using that discount rate, the present value of the social costs through 2030 is estimated to be $9.9 billion ($2001).

TABLE V.F-2 -- SUMMARY OF SOCIAL COSTS ESTIMATES ASSOCIATED WITH PRIMARY PROGRAM:2013, 2020, AND 2030 ($MILLION) [a, b]

	Maximum Cost Year (2013)			Year 2020			Final Year (2030)		
	Market Surplus ($\$10^6$)	Operating Savings ($\$10^6$)	Total	Market Surplus ($\$10^6$)	Operating Savings ($\$10^6$)	Total	Market Surplus ($\$10^6$)	Operating Savings ($\$10^6$)	Total
Engine Producers Total	$30.2		$30.2	$0.1		$0.1	$0.1		$0.1
Equipment Producers Total	$116.1		$116.1	$102.6		$102.6	$5.3		$5.3
Agricultural Equipment	$39.9		$39.9	$33.2		$33.2	$1.3		$1.3
Construction Equipment	$53.0		$53.0	$48.2		$48.2	$3.8		$3.8
Industrial Equipment	$23.2		$23.2	$21.2		$21.2	$0.2		$0.2
Application Producers & Consumers Total	$1,231.8	($241.9)	$989.8	$1,386.5	($190.1)	$1,196.3	$1,598.9	($174.5)	$1,424.5
Total Producer	*$515.7*			*$583.4*			*$672.9*		
Total Consumer	*$716.1*			*$803.1*			*$926.0*		
Agriculture	$348.7	($44.7)	$304.0	$339.2	($35.2)	$364.0	$416.5	($32.3)	$429.2
Construction	$468.3	($77.9)	$390.4	$550.4	($61.2)	$489.3	$635.7	($56.1)	$579.5
Manufacturing	$414.8	($119.3)	$295.5	$436.8	($93.8)	$343.0	$501.8	($86.0)	$415.7
Fuel Producers Total	$7.8		$7.8	$9.0		$9.0	$10.5		$10.5
PADD I&III	$3.6		$3.6	$4.1		$4.1	$4.8		$4.8
PADD II	$2.9		$2.9	$3.3		$3.3	$3.9		$3.9
PADD IV	$0.8		$0.8	$0.9		$0.9	$1.0		$1.0
PADD V	$0.5		$0.5	$0.6		$0.6	$0.8		$0.8
Nonroad Spillover		$51.2			$58.6			$69.2	
Marker Costs		$7.3			–			–	
Total	$1,385.8	($183.4)	$1,202.4	$1,498.2	($131.5)	$1,366.7	$1,614.9	($105.3)	$1,509.6

Notes:

[a] Figures are in 2001 dollars.

[b] Operating savings are shown as negative costs.

TABLE IV.F-3 -- NATIONAL ENGINEERING COMPLIANCE COSTS AND SOCIAL COSTS ESTIMATES FOR THE PROPOSED RULE: 2004 – 2030 ($$10^6$)[a]

Year	Engineering Compliance Costs	Total Social Costs[b]
2004	$0.00	$0.00
2005	$0.00	$0.00
2006	$0.00	$0.00
2007	$39.61	$39.61
2008	$130.41	$130.40
2009	$132.25	$132.25
2010	$262.02	$262.01
2011	$641.12	$641.07
2012	$1,010.37	$1,010.27
2013	$1,202.52	$1,202.40
2014	$1,329.14	$1,329.01
2015	$1,260.74	$1,260.62
2016	$1,298.40	$1,298.27
2017	$1,318.75	$1,318.62
2018	$1,325.02	$1,324.89
2019	$1,339.30	$1,339.16
2020	$1,366.79	$1,366.66
2021	$1,351.08	$1,350.94
2022	$1,349.58	$1,349.44
2023	$1,365.53	$1,365.38
2024	$1,371.60	$1,371.45
2025	$1,395.98	$1,395.83
2026	$1,419.79	$1,419.64
2027	$1,442.91	$1,442.76
2028	$1,465.41	$1,465.26
2029	$1,487.68	$1,487.53
2030	$1,509.77	$1,509.61
NPV at 3%	$16,524.29	$16,522.66
NPV at 7%	$9,894.02	$9,893.06

Notes:

[a] Figures are in 2001 dollars.

[b] Figures in this column do not include the human health and environmental benefits of the proposal.

VI. Alternative Program Options

Our proposed emission control program consists of a two-step program to reduce the sulfur content of nonroad diesel fuel in conjunction with the proposed Tier 4 engine standards. As we developed this proposal, we evaluated a number of alternative options with regard to the scope, level, and timing of the standards. This section presents a summary of our analysis of several alternative control scenarios. A complete discussion of all the alternatives, their feasibility, and their inventory, benefits, and cost impacts can be found in Chapter 12 of the draft Regulatory Impact Analysis for this proposal.

While we are interested in comments on all of the alternatives presented, we are especially interested in comments on two alternative scenarios which EPA believes merit further consideration in developing the final rule: a program in which sulfur levels are required to be reduced to 15 ppm in essentially a single step, and a variation on the proposed two-step fuel control program, in which the second step of sulfur control to 15 ppm in 2010 would apply to locomotive and marine diesel fuel in addition to nonroad diesel fuel. This section describes these two options in greater detail; additional information can be found in Chapter 12 of the draft Regulatory Impact Analysis for this proposal.

A. Summary of Alternatives

We developed emissions, benefits, and cost analyses for a number of alternatives. The alternatives we considered can be categorized according to the structure of their fuel requirements: whether the 15 ppm fuel sulfur limit is reached in two- steps, like the proposed program, or one-step.

One-step alternatives are those in which the fuel sulfur standard is applied in a single step: there are no fuel-based phase-ins. We evaluated three one-step alternatives. Option 1 is described in detail in Section VI.B, below. We considered two other one-step alternatives which differ from Option 1 in the timing of the fuel option (2006 or 2008) and the engines standards (level of the standards and when they are introduced). As described in Table IV-1, Option 1b differs from Option 1 regarding the timing of the fuel standards, while Option 1a differs from Option 1 in terms of the engine standards. Both Option 1a and 1b would also extend the 15 ppm fuel sulfur limit to locomotive and marine diesel fuel as well.

Two-step alternatives are those in which the fuel sulfur standard is set first at 500 ppm and then is reduced to 15 ppm. The two-step alternatives vary from the proposal in terms of both the timing and levels of the engine standards and the timing of the fuel standards. Option 2a is the same as the proposed program except the 500 ppm fuel standard is introduced a year earlier, in 2006. Option 2b is the same as the proposed program except the 15 ppm fuel standard is introduced a year earlier in 2009 and the trap-based PM standards begin earlier for all engines. Option 2c is the same as the proposed program except the 15 ppm fuel standard is introduced a year earlier in 2009 and the trap-based PM standards begin earlier for engines 175-750 hp. Option 2d is the same as the proposed program except the NOx standard is reduced to 0.30 g/bhp-hr for engines 25-75 hp, and this standard is phased in. Finally, Option 2e is the same as the proposed program except there are no new Tier 4 NOx limits.

Options 3 and 4 are identical to the proposed program, except Option 3 would exempt mining equipment over 750 hp from the Tier 4 standards, and Option 4 would include applying the 15 ppm sulfur limit to both locomotive and marine diesel fuel. Option 4 is discussed in detail in Section IV.C, below.

Option 5a and 5b are identical to the proposal except for the treatment of engines less than 75 hp. Option 5a is identical to the proposal except that no new program requirements would be set in Tier 4 for engines under 75 hp. Instead Tier 2 standards and testing requirements for engines under 50 hp, and Tier 3 standards and testing requirements for 50-75 hp engines, would continue indefinitely. The Option 5b program is identical to the proposal except that for engines under 75 hp only the 2008 engine standards would be set. There would be no additional PM filter-based standard in 2013 for 25-75 hp engines, and no additional NOx+NMHC standard in 2013 for 25-50 hp engines.

Table VI-1 contains a summary of a number of these alternatives and the expected emission reductions, costs, and monetized benefits associated with them in comparison to the proposal. These alternatives cover a broad range of possible approaches and serve to provide insight into the many other program design alternatives not expressly evaluated further. The analysis was done using a 3% discount rate. If we were to use another rate, the values would change but not to such a degree as to change our conclusions regarding the various options. A complete discussion of all the alternatives, their feasibility, and their inventory, benefits, and cost impacts can be found in Chapter 12 of the draft Regulatory Impact Analysis for this proposal.

TABLE VI-1 – SUMMARY OF ALTERNATIVE PROGRAM OPTIONS
(INCREMENTAL TO THE PROPOSAL)

Option	Fuel Standards	Engine Standards	Estimated Relative Inventory Impacts[c] (NPV tons thru 2030; 3% discount)	Estimated Cost Impacts - $Billion (NPV thru 2030; 3%)	Estimated Benefits Stream - $Billion[e] (NPV thru 2030; 3%)
Proposal ***(inventory impacts, costs and benefits reported below for the options are compared to the proposal)***					
	• 500 PPM in 2007 for NR, loco/marine • 15 ppm in 2010 NR only	• >25 hp: PM AT introduced 2013 • >75 hp: NOx AT introduced and phased-in 2011-2013 • <25 hp: PM stds in 2008 • 25-75 hp: PM stds in 2008 (optional for 50-75 hp)	Relative to baseline: 1,126,000 PM 4,952,000 SO2 5,591,000 NOx+NMHC	$16.7	$550[b]
1-Step Fuel Options					
1	• 15 ppm in 2008 for NR only • 500 ppm in 2008 for loco/marine	• < 50 hp: PM stds only in 2009 • 25-75 hp: PM AT stds and EGR or equivalent NOx technology in 2013; no NOx AT • >75 hp: PM AT stds phasing in beginning in 2009; NOx AT phasing in beginning in 2011	6,000 PM -191,000 SO2 11,000 NOx+NMHC	$1.7[d]	$.2[b]
1a	• 15 ppm in 2008 for NR, loco/marine	• PM AT introduced in 2009-10 • NOx AT introduced in 2011-12	129,000 PM -63,000 SO2 1,843,000 NOx+NMHC	a	$59
1b	• 15 ppm in 2006 for NR, loco/marine	Same as 1a		a	
2-Step Fuel Options					
2a	Same as proposal except – • 500 ppm in 2006 for NR, loco/marine	Same as proposal	18,000 PM 228,000 SO2 0 NOx+NMHC	a	$7[b]
2b	Same as proposal except – • 15 ppm in 2009 for NR	Same as proposal except – • Move PM AT up 1 year for all engines > 25 hp (phase in starts 2010)	54,000 PM 17,000 SO2 36,000 NOx+NMHC	$1.2[d]	$16[b]

Option	Fuel Standards	Engine Standards	Estimated Relative Inventory Impacts[c] (NPV tons thru 2030; 3% discount)	Estimated Cost Impacts - $Billion (NPV thru 2030; 3%)	Estimated Benefits Stream - $Billion[e] (NPV thru 2030; 3%)
2c	Same as proposal except – • 15 ppm in 2009 for NR	Same as proposal except – • Move PM AT up 1 year for all engines 175-750 hp (phase in starts 2010)	20,000 PM 17,000 SO2 16,000 NOx+NMHC	$0.8[d]	$6[b]
2d	• Same as proposal	Same as proposal except – • Phase-in NOx AT for 25-75hp beginning in 2013	0 PM 0 SO2 751,000 NOx+NMHC	a	$10[b]
Other Options					
3	• Same as proposal	Same as proposal except – • Mining equipment over 750 hp left at Tier 2	-30,000 PM 0 SO2 -751,000 NOx+NMHC	-$0.5	-$18[b]
4	Same as proposal except – • loco/marine fuel to 15 ppm in 2010	Same as proposal	9,000 PM 114,000 SO2 0 NOx+NMHC	$1.8	$6[b]
5a	• Same as proposal	Same as proposal except- • No Tier 4 standards <75 hp	-209,000 PM 0 SO2 -334,000 NOx+NMHC	-$3.8	-$70
5b	• Same as proposal	Same as proposal except- • No new <75hp standards after 2008 (i.e., no CDPFs in 2013)	-121,000 PM 0 SO2 -333,000 NOx+NMHC	-$2.6	-$43

Notes:

[a] Qualitative analysis only. Option is impractical due to infeasibility or other significant concerns. See the draft RIA for a detailed discussion

[b] By benefits transfer method

[c] Net Present (2004) Value impacts through 2030, using a 3% discount rate, relative to the proposed program. Positive values mean that the Option produces greater emission reductions from baseline than the proposed program.

[d] Cost estimates do not include the costs due to potential for limited product offerings and market disruptions in the engine/equipment and/or fuel markets. See Section V of this preamble and the draft FIA for a detailed discussion.

[e] Benefits do not include CO, VOC, air toxics, ozone, and PM welfare benefits. See Section V.F of this preamble and the draft RIA for additional discussion.

B. Introduction of 15 ppm Nonroad Diesel Sulfur Fuel in One Step

EPA carefully evaluated and is seeking comment on alternative regulatory approaches. Instead of the proposed two-step reduction in nonroad diesel sulfur, one alternative would require that the nonroad diesel sulfur level be reduced to 15ppm beginning June 1, 2008. This alternative would have the advantage of enabling use of high efficiency exhaust emission control technology for nonroad engines as early as the 2009 model year. It also would have several disadvantages which have prompted us not to propose it. The disadvantages in comparison to the proposal include inadequate lead-time for engine and equipment manufacturers and refiners, leading to increased costs and potential market disruptions. In this section, we describe this alternative in greater detail and discuss potential engine and fuel impacts. We also present our estimated emission and benefit impacts. Two other one-step fuel options which are variations of the alternative discussed in this section, Options 1a and 1b in Table VI-1, are presented in Chapter 12 of the draft RIA for this proposal.

1. Description of the One-Step Alternative

While numerous engine standards and phase-in schedules are possible, we considered the standards shown in Tables VI-2 and VI-3 as being the most stringent one-step program that could be considered potentially feasible considering cost, lead-time, and other factors. These standards are similar to those in our proposed option, the primary difference being the generally earlier phase-in dates for the PM standards.

TABLE VI-2 – PM STANDARDS FOR 1-STEP FUEL SCENARIO (G/BHP-HR)

<table>
<tr><th rowspan="2">Engine Power</th><th colspan="6">Model Year</th></tr>
<tr><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td>hp <25</td><td>0.30</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>25 ≤ hp < 50</td><td>0.22</td><td></td><td></td><td></td><td>0.02</td><td></td></tr>
<tr><td>50 ≤ hp < 75</td><td></td><td></td><td></td><td></td><td>0.02</td><td></td></tr>
<tr><td rowspan="2">75 ≤ hp < 175</td><td rowspan="2"></td><td colspan="3">0.01</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>50%[a]</td><td>50%[a]</td><td>100%[a]</td></tr>
<tr><td rowspan="2">175 ≤ hp < 750</td><td colspan="3">0.01</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>50%[a]</td><td>50%[a]</td><td>100%[a]</td></tr>
<tr><td rowspan="2">hp ≥ 750</td><td rowspan="2"></td><td rowspan="2"></td><td colspan="4">0.01</td></tr>
<tr><td>50%[a]</td><td>50%[a]</td><td>50%[a]</td><td>100%[a]</td></tr>
</table>

Notes:
[a] Percentages are the model year sales required to comply with the indicated standard.

Table VI-3 – NOx and NMHC Standards for 1-Step Fuel Scenario (g/bhp-hr)

Engine Power	Model Year			
	2011	2012	2013	2014
25 ≤ hp < 75			3.5 [a]	
75 ≤ hp < 175		0.30 NOx 0.14 NMHC		
		50% [b]	50% [b]	100% [b]
175 ≤ hp < 750	0.30 NOx 0.14 NMHC			
	50% [b]	50% [b]	50% [b]	100% [b]
hp ≥ 750	0.30 NOx 0.14 NMHC			
	50% [b]	50% [b]	50% [b]	100% [b]

Notes:
[a] A 3.5 NMHC + NOx standard would apply to the 25-50 hp engines. Engines greater than 50hp are already subject to this standard in 2008 under the existing Tier 3 program.
[b] Percentages are the model year sales required to comply with the indicated standards.

2. Engine Emission Impacts

The main advantage associated with this one-step approach is pulling ahead the long-term PM engine standards. By making 15 ppm sulfur fuel widely available by late 2008, we could accelerate the long-term PM engine standards, leading to the introduction of precious metal catalyzed PM traps as early as 2009, two years earlier than possible under the two-step sulfur reduction approach. Some stakeholders have expressed the concern that a two-step approach leads to later than desired introduction of high-efficiency exhaust emissions controls on nonroad diesels because this cannot happen until the 15 ppm fuel standard goes into effect. As shown in Table VI-1, there would be additional public health benefits associated with this one-step approach. However, in comparison to the proposal, the additional benefits are relatively small, less than one percent or about $3 billion more than the proposed program.[295]

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[295] A variation on this one-step approach would be to also require the sulfur content of locomotive and marine fuel to meet the 15 ppm standard in 2008. The decision of whether or not to require the sulfur content of locomotive and marine fuel to also be reduced to 15 ppm, however, is not unique to the one step approach, and, as

Even though 15 ppm fuel would be available beginning June 1, 2008 under this one-step approach, we do not believe it would be feasible to propose an aggressive turnover of new engines to trap-equipped versions in 2009. Nor would it be possible to introduce NOx controls any earlier than we are already proposing, model year 2011. The proposed standards need to be coordinated with Tier 3 standards, and with the heavy duty highway diesel standards. The coordination of Tier 4 standards with Tier 3 standards and with the development of emissions control technology for highway diesel engines is of critical importance to successful implementation of the Tier 4 standards. Even those manufacturers who do not make highway engines are expected to gain substantially from the highway PM and NOx control development work, provided they can plan for standards set at a similar level of stringency and timed in a way to allow for the orderly migration of highway engine technology to nonroad applications.

Thus, although the application of high-efficiency exhaust PM emission controls to nonroad diesels would be enabled with the introduction of 15 ppm sulfur nonroad fuel in 2008 under a one-step program, we believe that to require the application of PM controls across the wide spectrum of nonroad engines shortly thereafter would raise serious feasibility concerns that could only be resolved, if at all, through a very large additional R&D effort undertaken roughly in parallel with the similarly large highway R&D effort, a duplication of effort we wish to avoid for reasons discussed in Section III. Nonroad engine designers would need to accomplish much of this development well before the diesel experience begins to accumulate in earnest in 2007, in order to be ready for a 2009 first introduction date. Waiting until 2007 before initiating 2009 model year design work would risk the possibility of product failures, limited product availability and major market disruptions. At the same time, for those engine manufacturers who participate in both the highway and nonroad diesel engine markets, attempting to have concurrent engine product developments for highway and nonroad, could result in the possibility of product failures, limited product availability and major disruptions for the highway market as well. Thus, in balancing their costs and burden, many manufacturers may be forced to choose which products would be available for 2009 and which products would be delayed for release. Manufacturers would also incur large additional costs to redesign hundreds of engine models and thousand of machine types to meet Tier 4 standards only one to three years after Tier 3 standards take effect in 2006-2008. These cost impacts are reflected in Table VI-1 and their derivation is explained in chapter 12 of the draft RIA. This extra expenditure could only be modestly mitigated by phasing in the standards, since a crash R&D effort with limited benefit from highway experience would still be necessary.

Moreover, with respect to NOx, it would be impractical or simply infeasible to pull the standards ahead on the same schedule. This is because EPA's highway diesel program allows manufacturers to phase in NOx technology over 2007-2010. As a result, we do not expect that the high-efficiency NOx control technology could reasonably be applied to nonroad engines any earlier under a one-step program than under a two-step program (i.e., beginning in 2011).

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discussed below is an alternative also being evaluated under our proposed 2-step program. Were we to require locomotive and marine diesel fuel to also meet the 15 ppm standard in 2008 under a one-step approach, there would be additional inventory reductions of about 10,000 tons of PM and 128,000 tons of SO_2 (NPV 3% through 2030).

In summary, this option would lead us to apply PM and NOx standards in two different model years, or else forgo any opportunity to apply PM traps in 2009. Redesigning engines and emission controls for early PM control and then again a couple of years later for NOx control, on top of shortened Tier 3 stability periods, would likely add substantial costs to the program. As manufacturers attempt to avoid these costs and optimize their development they may simply have to restrict product offerings for some period, leading to price spikes and shortages due to lack of product availability. Having the NOx and PM standards phase in simultaneously under our proposed approach avoids cost and design stability issues for both engine and equipment manufacturers. In addition, the longer leadtime for the engine standards under our proposed program will allow greater economic efficiencies for engine manufacturers as they transfer highway emission reduction technology to nonroad engines.

3. Fuel Impacts

In addition to the challenges associated with pulling ahead the PM standards described above, there are also some concerns regarding the practicality of an early 15 ppm nonroad diesel sulfur standard. A one-step approach may result in several economic inefficiencies that would increase the cost of the program. For example, refiners will have little opportunity to take advantage of the newer desulfurization technologies currently being developed. As described in Section IV and V, refiners will only begin to be able to take advantage of these new technologies in 2008. By 2010, the ability to incorporate them into their refinery modifications is expected to double. If refiners have to take steps to reduce the sulfur content of nonroad diesel fuel earlier, they will likely have to use more expensive current technology. The cost impacts of this decision will persist, since the choice of technology is a long term decision. If a refiner is forced by the effective date of the standards to employ a more expensive technology, that choice will affect that refiner's output indefinitely, since the cost of upgrading to the new technologies will be prohibitive. As presented in Section 5.2 of the Draft RIA, we estimate that the costs of achieving a 15 ppm standard in 2008 is approximately 0.4 c/gal greater than for the proposal. While difficult to quantify there are also considerable advantages to allowing refiners some operating time in producing 15 ppm diesel fuel for the highway program prior to requiring them to solidify their designs for producing nonroad diesel fuel to 15 ppm. The primary advantage is that the design of desulfurization equipment used to produce 15 ppm nonroad diesel fuel can reflect the operating experience of the equipment used to produce 15 ppm highway diesel fuel starting in 2006. This extra time would also provide current refiners of high sulfur diesel fuel with highly confident estimates of the cost of producing 15 ppm diesel fuel, reducing uncertainty and increasing their likelihood of investing to produce this fuel. With a start date of June 1, 2008 refiners would have to solidify their designs and start construction prior to getting any data on the performance of their highway technology. This would increase the cost of producing 15 ppm nonroad diesel fuel for the life of the new desulfurization equipment, as well as potentially delaying some refiners' decision to invest in new desulfurization equipment due to uncertainties in cost, performance, etc.

4. Emission and Benefit Impacts

We used the nonroad model to estimate the emission inventory impacts associated with this one-step option, as well as the other options listed in Table VI-1. As for all the alternatives, we then used the benefits transfer method to estimate the monetized benefits of the alternative.[296] The results are shown in Table VI-1. As is evidenced by the values in Table VI-1, the one-step alternative would achieve slightly greater PM and NOx emission reductions through 2030 than the proposed 2-step program, with 6,000 and 11,000 additional tons reduced, respectively (or less than 0.5 percent). Unlike the proposed 2-step program, however, there would be no SO2 emission reductions in 2007 due to the delay in fuel sulfur control, although 2009 and later emission are slightly greater due primarily to the earlier introduction of engines using PM filters. Nevertheless, the SO2 benefits of the one-step program are slightly less than the proposed 2-step program in the long run, by about 191,000 tons (about 4 percent) through 2030.

After careful consideration of these matters, we have decided to propose the two-step approach in today's notice. The two-step program avoids adverse risks to the smooth implementation of the entire Tier 4 nonroad program that could be caused by the significantly shortened lead-time and stability of the one-step program. There are also concerns about the potential negative impacts the one-step option may have on the 2007 highway program, including the implications of the overlap of implementation schedules (see above and Chapter 12 of the draft RIA). Nevertheless, we believe that the one-step approach is a regulatory alternative worth considering. In addition to seeking comment on our proposed program, we also seek comment on the relative merits and shortcomings of a one-step approach to regulating nonroad diesel fuel and the associated schedule for implementing the engine standards.

C. Applying 15 ppm Requirement to Locomotive and Marine Diesel Fuel

To enable the high efficiency exhaust emission control technology to begin to be applied to nonroad diesel engines beginning with the 2011 model year, we are proposing that all nonroad diesel fuel produced or imported after June 1, 2010 would have to meet a 15 ppm sulfur cap. Although locomotive and marine diesel engines are similar in size to some of the diesel engines covered in this proposal, there are many differences that have caused us to treat them separately in past EPA programs.[297] These include differences in duty cycles and exhaust system design configurations, size, and rebuild and maintenance practices. Because of these differences, we are

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[296] The results that were obtained for Option 1a were extrapolated based on the emission inventory changes to the proposed program and were obtained for the other alternatives by assuming the air quality changes between the alternative and the actual case run were small enough to allow for such extrapolation. An explanation of the benefits transfer method is contained in Chapter 9 of the draft RIA.

[297] Locomotives, in fact, are treated separately from other nonroad engines and vehicles in the Clean Air Act, which contains provisions regarding them in section 213(a)(5). Less than 50 hp marine engines were included in the 1998 final rule for nonroad diesel engines, albeit with some special provisions to deal with marine-specific engine characteristics and operating cycles.

not proposing new engine standards today for these engine categories. Since we are not proposing more stringent emission standards, we are also not proposing that the second step of sulfur control to 15 ppm in 2010 be applied to locomotive and marine diesel fuel. Instead, we are proposing to set a sulfur fuel content standard of 500 ppm for diesel fuel used in locomotive and marine applications. This fuel standard is expected to provide considerable sulfate PM and SO2 benefits even without establishing more stringent emission standards for these engines. We estimate that, cumulatively through 2030, reducing the sulfur content of locomotive and marine diesel fuel would eliminate about 102,000 tons of sulfate PM (net present value, based on a 3 percent discount rate).

As discussed in Section IV, we are seriously considering the option of extending the 15 ppm sulfur standard to locomotive and marine fuel as early as June 1, 2010, including them in the second step of the proposed two-step program. There are several advantages associated with this alternative. First, as reflected in Table VI-1, it would provide important additional sulfate PM and SO2 emission reductions and the estimated benefits from these reductions would outweigh the costs by a considerable margin. Second, in some ways it would simplify the fuel distribution system and the design of the fuel program proposed today since a marker would not be required for locomotive and marine diesel fuel. Furthermore, the prices for locomotive and marine diesel fuel may be virtually unaffected. Under the proposal, we expect that a certain amount of marine fuel will be 15 ppm sulfur fuel regardless of the standard due to limitations in the production and distribution of unique fuel grades. Where 500 ppm fuel is available, the possible suppliers of fuel will likely be more constrained, limiting competition and allowing prices to approach that of 15 ppm fuel. If we were to bring locomotive and marine fuel to 15 ppm, the pool of possible suppliers could expand beyond those today, since highway diesel fuel will also be at the same standard. Third, it would help reduce the potential opportunity for misfueling of 2007 and later model year highway vehicles and 2011 and later model year nonroad equipment with higher sulfur fuel. Finally, it would allow refiners to coordinate plans to reduce the sulfur content of all of their nonroad, locomotive, and marine diesel fuel at one time. While in many cases this may not be a significant advantage, it may be a more important consideration here since it is probably not a question of whether locomotive and marine fuel must meet a 15 ppm cap, but merely when. As discussed in Section IV, it is the Agency's intention to propose action in the near future to set new emission standards for locomotive and marine engines that could require the use of high efficiency exhaust emission control technology, and thus, also require the use of 15 ppm sulfur diesel fuel.[298] We anticipate that such engine standards would likely take effect in the 2011-13 timeframe, requiring 15 ppm locomotive and marine diesel fuel in the 2010-12 timeframe. We intend to publish an advance notice of proposed rulemaking for such standards by the Spring of 2004 and finalize those standards by 2007.

However, discussions with refiners have suggested there are significant advantages to leaving locomotive and marine diesel fuel at 500 ppm, at least in the near-term and until we set more stringent standards for those engines. The locomotive and marine diesel fuel markets could provide an important market for off-specification product, particularly during the transition to 15

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[298] EPA established the most recent new standards for locomotives and marine diesel engines (including those under 50 hp) in separate actions (63 FR 18977, April 16, 1998, and 67 FR 68241, November 8, 2002).

ppm for highway and nonroad diesel fuel in 2010. Waiting just a year or two beyond 2010 would address the critical near-term needs during the transition. In addition, waiting just another year or two beyond 2010 is also projected to allow virtually all refiners to take advantage of the new lower cost technology.

After careful consideration of these matters, we have decided not to propose to apply the second step of sulfur control of 15 ppm to locomotive and marine diesel fuel at this time. Nevertheless, for the reasons described above, we are carefully weighing whether it would be appropriate to do so. Therefore, we seek comment on this alternative and the various advantages, disadvantages, and implications of it.

D. Other Alternatives

We have also analyzed a number of other alternatives, as summarized in Table VI-1. Some of these focus on control options more stringent than our proposal while others reflect modified engine requirements that result in less stringent control. EPA has evaluated these options in terms of the feasibility, emissions reductions, costs, and other relevant factors. EPA believes the proposed approach is the proper one with respect to these factors, and believes the options discussed above while having possible merit in some areas, raise what we believe are different and significant concerns with respect to these factors compared to the proposed approach. Hence we did not include these options. These concerns are discussed in more detail in Chapter 12. These concerns are discussed in more detail in Chapter 12 of the draft RIA. Hence, we did not include these options as part of our proposal for nonroad fuel and engine controls. We are interested in comment on these alternatives, especially information regarding their feasibility, costs, and other relevant concerns.

VII. Requirements for Engine and Equipment Manufacturers

This section describes the regulatory changes proposed for the engine and equipment compliance program. First, the proposed regulations for Tier 4 engines have been written in plain language. They are structured to contain the provisions that are specific to nonroad CI engines in a new proposed part 1039, and to apply the general provisions of existing parts 1065 and 1068. The proposed plain language regulations, however, are not intended to significantly change the compliance program, except as specifically noted in today's notice (and we are not soliciting comment on any part of the rule that remains unchanged substantively). As proposed, these plain language regulations would only apply for Tier 4 engines. The changes from the existing nonroad program are described below along with other notable aspects of the compliance program.

A. Averaging, Banking, and Trading

1. Are we proposing to keep the ABT program for nonroad diesel engines?

EPA has included averaging, banking, and trading (ABT) programs in most mobile source emission control programs adopted in recent years. Our existing regulations for nonroad diesel engines include an ABT program (§89.201 through §89.212). We are proposing to retain the basic structure of the existing nonroad diesel ABT program with today's notice, though we are proposing a number of changes to accommodate implementation of the proposed emission standards. Behind these changes is the recognition that the proposed standards represent a major technological challenge to the industry. The proposed ABT program is intended to enhance the ability of engine manufacturers to meet the stringent standards proposed today. The proposed program is also structured to limit production of very high-emitting engines and to avoid unnecessary delay of the transition to the new exhaust emission control technology.

We view the proposed ABT program as an important element in setting emission standards that are appropriate under CAA section 213 with regard to technological feasibility, lead time, and cost. The ABT program helps to ensure that the stringent standards we are proposing are appropriate under section 213(a) given the wide breadth and variety of engines covered by the standards. For example, if there are engine families that will be particularly costly or have a particularly hard time coming into compliance with the standard, this flexibility allows the manufacturer to adjust the compliance schedule accordingly, without special delays or exceptions having to be written into the rule. Emission-credit programs also create an incentive (for example, to generate credits in early years to create compliance flexibility for later engines) for the early introduction of new technology, which allows certain engine families to act as trailblazers for new technology. This can help provide valuable information to manufacturers on the technology before they apply the technology throughout their product line. This early introduction of clean technology improves the feasibility of achieving the standards and can provide valuable information for use in other regulatory programs that may benefit from similar technologies. Early introduction of such engines also secures earlier emission benefits.

In an effort to make information on the ABT program more available to the public, we intend to issue periodic reports summarizing use of the proposed ABT program by engine manufacturers. The information contained in the periodic reports would be based on the information submitted to us by engine manufacturers, and summarized in a way that protects the confidentiality of individual engine manufacturers. We believe this information will also be helpful to engine manufacturers by giving them a better indication of the availability of credits. Again, our periodic reports would not contain any confidential information submitted by individual engine manufacturers, such as sales figures. Also, the information would be presented in a format that would not allow such confidential information to be determined from the reports.

2. What are the provisions of the proposed ABT program?

The following section describes the changes proposed to the existing ABT program. In addition to those areas specifically highlighted, we are soliciting comments on all aspects of the proposed ABT changes, including comments on the need for and benefit of these changes to manufacturers in meeting the proposed emission standards.

The ABT program has three main components. Averaging means the exchange of emission credits between engine families within a given engine manufacturer’s product line. (Engine manufacturers divide their product line into “engine families” that are comprised of engines expected to have similar emission characteristics throughout their useful life.) Averaging allows a manufacturer to certify one or more engine families at levels above the applicable emission standard, but below a set upper limit. However, the increased emissions must be offset by one or more engine families within that manufacturer’s product line that are certified below the same emission standard, such that the average emissions from all the manufacturer's engine families, weighted by engine power, regulatory useful life, and production volume, are at or below the level of the emission standard. (The inclusion of engine power, useful life, and production volume in the averaging calculations is designed to reflect differences in the in-use emissions from the engines.) Averaging results are calculated for each specific model year. The mechanism by which this is accomplished is certification of the engine family to a "family emission limit" (FEL) set by the manufacturer, which may be above or below the standard. An FEL that is established above the standard may not exceed an upper limit specified in the ABT regulations. Once an engine family is certified to an FEL, that FEL becomes the enforceable emissions limit for all the engines in that family for purposes of compliance testing. Averaging is allowed only between engine families in the same averaging set, as defined in the regulations.

Banking means the retention of emission credits by the engine manufacturer for use in future model year averaging or trading. Trading means the exchange of emission credits between nonroad diesel engine manufacturers which can then be used for averaging purposes, banked for future use, or traded to another engine manufacturer.

The existing ABT program for nonroad diesel engines covers NMHC+NOx emissions as well as PM emissions. With today’s notice we are proposing to make the ABT program available for the proposed NOx standards and proposed PM standards. (For engines less than 75 horsepower where we are proposing combined NMHC+NOx standards, the ABT program would continue to be available for the proposed NMHC+NOx standards as well as the proposed PM standards.) ABT would not be available for the proposed NMHC standards for engines above 75 horsepower or for the proposed CO standards for any engines.

As noted earlier, the existing ABT program for nonroad diesel engines includes FEL caps -- limits on how high the emissions from credit-using engine families can be. No engine family may be certified above these FEL caps. These limits provide the manufacturers compliance flexibility while protecting against the introduction of unnecessarily high-emitting engines. When we propose new standards, we typically propose new FEL caps for the new standards. In the past, we have generally set the FEL caps at the emission levels allowed by the previous standard, unless there was some specific reason to do otherwise. We are proposing to do otherwise here because the proposed standard levels in today's notice are so much lower than the current standards levels, especially the Tier 4 standards for engines above 75 horsepower. The transfer to new technology is feasible and appropriate. Thus, to ensure that the ABT provisions are not used to continue producing old-technology high-emitting engines under the new program, the proposed FEL caps would not, in general, be set at the previous standards. An exception is for the proposed NMHC+NOx standard for engines between 25 and 50 horsepower effective in model year 2013, where we are proposing to use the previously applicable NMHC+NOx standard for the FEL cap since the gap between the previous and proposed standards is approximately 40 percent (rather than 90 percent for engines above 75 horsepower).

For engines above 75 horsepower certified during the phase-in period, there would be two separate sets of engines with different FEL caps. For engines certified to the existing (Tier 3) NMHC+NOx standards during the phase-in, the FEL cap would necessarily continue to be the existing FEL caps as adopted in the October 1998 rule. For engines certified to the proposed Tier 4 NOx standard during the phase-in, the FEL cap would be 3.3 g/bhp-hr for engines between 75 and 100 horsepower, 2.8 g/bhp-hr for engines between 100 and 750 horsepower, and 4.6 g/bhp-hr for engines above 750 horsepower. These proposed NOx FEL caps represent an estimate of the NOx emission level that is expected under the combined NMHC+NOx standards that apply with the existing previous tier standards. Beginning in model year 2014 when the proposed Tier 4 NOx standard for engines above 75 horsepower take full effect, we are proposing a NOx FEL cap of 0.60 g/bhp-hr for engines above 75 horsepower. (As described below, we are proposing to allow a small number of engines greater than 75 horsepower to have NOx FELs above the 0.60 g/bhp-hr cap beginning in model year 2014.) Given the fact that the proposed Tier 4 NOx standard is approximately a 90 percent reduction from the existing standards for engines above 75 horsepower, we do not believe the previous standard would be appropriate as the FEL cap for all engines once the Tier 4 standards are fully phased-in. We believe that the proposed NOx FEL caps will ensure that manufacturers adopt NOx aftertreament technology across all of their engine designs (with the exception of a limited number) but will also allow for some meaningful use of averaging during the phase-in period. When compared to the proposed 0.30 g/bhp-hr NOx standard, the proposed NOx FEL cap of 0.60 g/bhp-hr (effective when the Tier 4 standards are fully phased-in) is consistent with FEL caps set in previous rulemakings.

For the transitional PM standards being proposed for engines between 25 and 75 horsepower effective in model year 2008 and for the Tier 4 PM standards for engines below 25 horsepower, we are proposing the previously applicable Tier 2 PM standards (which do vary within the 25 to 75 horsepower category) for the FEL caps since the gap between the previous and proposed standards is approximately 50 percent (rather than in excess of 90 percent for engines above 75 horsepower). For the proposed Tier 4 PM standard effective in model year 2013 for engines between 25 and 75 horsepower, we are proposing a PM FEL cap of 0.04 g/bhp-hr, and for the proposed Tier 4 PM standard effective in model years 2011 and 2012 for engines between 75 and 750 horsepower, we are proposing a PM FEL cap of 0.03 g/bhp-hr. (As described below, we are proposing to allow a small number of Tier 4 engines greater than 25 horsepower to have PM FELs above these caps.) Given the fact that the proposed Tier 4 PM standards for engines above 25 horsepower are less than 10 percent of the previous standards, we do not believe the previous standards would be appropriate as FEL caps once the Tier 4 standards take effect. We believe that the proposed PM FEL caps will ensure that manufacturers adopt PM aftertreament technology across all of their engine designs (except for a limited number of engines), yet will still provide substantial flexibility in meeting the standards.

For the proposed Tier 4 PM standards for engines above 750 horsepower there is a phase-in period during model years 2011 through 2013. During the phase-in period, there would be two separate sets of engines with different FEL caps. For engines certified to the existing Tier 2 PM standard, the FEL cap would continue to be the existing PM FEL cap adopted in the October 1998 rule. For engines certified to the proposed Tier 4 PM standard during the phase-in, the FEL cap would be 0.15 g/bhp-hr (the PM standard for the previous tier). Beginning in model year 2014, when the proposed Tier 4 PM standard for engines above 750 horsepower takes full effect, consistent with the proposed caps for lower horsepower categories, we are proposing a PM FEL cap of 0.03 g/bhp-hr. (As described below, we are proposing to allow a small number of engines greater than 750 horsepower to have PM FELs above the 0.03 g/bhp-hr cap beginning in model year 2014.) We believe that the proposed PM FEL caps for engines above 750 horsepower will ensure that manufacturers adopt PM aftertreament technology across all of their engine designs once the standard is fully phased-in (with the exception of a limited number) while allowing for some meaningful use of averaging during the phase-in period.

Table VII.A-1 contains the proposed FEL caps and the effective model year for the FEL caps (along with the associated standards proposed for Tier 4). We request comment on the need for and the levels of these proposed FEL caps. It should be noted that for Tier 4, where we are proposing a new transient test, as well as retaining the current steady-state test, the FEL established by the engine manufacturer would be used as the enforceable limit for the purpose of compliance testing under both test cycles. In addition, under the NTE requirements, the FEL times the appropriate multiplier would be used as the enforceable limit for the purpose of such compliance testing.

TABLE VII.A-1 -- PROPOSED FEL CAPS FOR THE PROPOSED TIER 4 STANDARDS IN THE ABT PROGRAM (G/BHP-HR)

Power Category	Effective Model Year	NOx Standard	NOx FEL Cap	PM Standard	PM FEL Cap
hp <25 (kW <19)	2008+	–[a]	–[a]	0.30[b]	0.60
25 ≤ hp < 50 (19 ≤ kW < 37)	2008-2012[c]	–[a]	–[a]	0.22	0.45
25 ≤ hp < 50 (19 ≤ kW < 37)	2013+[d]	3.5[e]	5.6[e]	0.02	0.04[f]
50 ≤ hp < 75 (37 ≤ kW < 56)	2008-2012	–[a]	–[a]	0.22	0.30
50 ≤ hp < 75 (37 ≤ kW < 56)	2013+	–[a]	–[a]	0.02	0.04[f]
75 ≤ hp < 175 (56 ≤ kW <130)	2012-2013[g]	0.30	3.3 for hp < 100 2.8 for hp ≥ 100	0.01	0.03[f]
75 ≤ hp < 175 (56 ≤ kW <130)	2014+	0.30	0.60[f]	0.01	0.03[f]
175 ≤ hp ≤ 750 (130 ≤ kW ≤ 560)	2011-2013	0.30	2.8	0.01	0.03[f]
175 ≤ hp ≤ 750 (130 ≤ kW ≤ 560)	2014+	0.30	0.60[f]	0.01	0.03[f]
hp > 750 (kW >560)	2011-2013	0.30	4.6	0.01	0.15
hp > 750 (kW >560)	2014+	0.30	0.60[f]	0.01	0.03[f]

Notes:
[a] The existing NMHC+NOx standard and FEL cap apply (see CFR Title 40, section 89.112).
[b] A PM standard of 0.45 g/bhp-hr would apply to air-cooled, hand-startable, direct injection engines under 11 horsepower, effective in 2010.
[c] The proposed FEL caps do not apply if the manufacturer elects to comply with the optional standards. The existing FEL caps continue to apply.
[d] FEL caps apply in model year 2012 if the manufacturer elects to comply with the optional standards.
[e] These are a combined NMHC+NOx standard and FEL cap.
[f] As described in this section, a small number of engines are allowed to exceed these FEL caps.
[g] This period would extend through the first nine months of 2014 under the alternative, reduced phase-in requirement (see Section III.B.1. for a description of the proposed alternative).

As noted above, we are proposing to allow a limited number of engines to have a higher FEL than the caps noted in Table VII.A-1 in certain instances. Under this proposal, the allowance to certify up to these higher FEL caps would apply to Tier 4 engines at or above 25 horsepower. The provisions are intended to provide some limited flexibility for engine manufacturers as they transition to the stringent standards while ensuring that the vast majority of engines are converted to the advanced low-emission technologies expected under the Tier 4 program. This additional lead time appears appropriate, given the potential that a limited set of nonroad engines may face especially challenging difficulties in complying, and considering further that the same amount of overall emission reductions would be achieved through the need for credit-generating nonroad engines.

Beginning the first year Tier 4 standards apply in each power category above 25 horsepower, an engine manufacturer would be allowed to certify up to ten percent of its engines in each power category with PM FELs above the caps shown in Table VII.A-1. The PM FEL cap for such engines would instead be the applicable previous tier PM standard. The ten percent allowance would be available for the first four years the Tier 4 standards apply. For the power categories in which we are proposing a phase-in requirement for the Tier 4 NOx standards, the allowance to use a higher FEL cap would apply only to PM during the phase-in years. Once the phase-in period is complete, the allowance would apply to NOx as well. (For engines above 750 horsepower, where we are proposing a phase-in for both NOx and PM, the allowance to use a higher FEL cap would not take effect until model year 2014 when the phase-in was complete.)

After the fourth year the Tier 4 standards apply, the allowance to certify engines using the higher FEL caps would still be available but for no more than five percent of a manufacturer's engines in each power category. (For the power category between 25 and 75 horsepower, this allowance would apply beginning with the 2013 model year and would apply to PM. The allowance to use the higher FEL caps is not necessary for the 2008 proposed standards or the 2013 proposed NMHC+NOx standards because the FEL caps for those standards are set at the previously applicable tier standards.)

Table VII.A-2 presents the model years, percent of engines, and higher FEL caps that would apply under this allowance. Because the engines certified with the higher FEL caps are certified to the Tier 4 standards (albeit through the use of credits), they would be considered Tier 4 engines and all other requirements for Tier 4 engines would also apply, including the Tier 4 NMHC standard. We invite comment on whether additional provisions may be necessary for the limited number of engines certified to the higher FELs, including whether an averaging program for NMHC would be needed.

TABLE VII.A-2 -- ALLOWANCE FOR LIMITED USE OF AN FEL CAP HIGHER THAN THE TIER 4 FEL CAPS

Power Category	Model Years	Engines Allowed to have Higher FELs	NOx FEL Cap (g/bhp-hr)	PM FEL Cap (g/bhp-hr)
$25 \leq hp < 75$ ($19 \leq kW < 56$)	2013-2016	10%	Not applicable	0.22
	2017+	5%		
$75 \leq hp < 175$ ($56 \leq kW < 130$)	2012-2013[a]	10%	Not applicable	0.30 for hp <100 0.22 for hp $\geq$100
	2014-2015	10%	3.3 for hp <100 2.8 for hp $\geq$100	
	2016+	5%		
$175 \leq hp \leq 750$ ($130 \leq kW \leq 560$)	2011-2013	10%	Not applicable	0.15
	2014	10%	2.8	
	2015+	5%		
hp > 750 (kW >560)	2014-2017	10%	4.6	0.15
	2018+	5%		

Notes:
[a] This period would extend through the first nine months of 2014 under the alternative, reduced phase-in requirement (see Section III.B.1. for a description of the proposed alternative).

We request comment on the proposed provisions to allow higher FELs on a limited number of Tier 4 engines, including whether the proposed allowance limits of 10 percent and 5 percent have been set at the right levels and whether the allowance to use a higher FEL cap is appropriate for the Tier 4 program. We also request comment on allowing manufacturers to use the allowances in a slightly different manner over the first four years. Instead of allowing manufacturers to certify up to ten percent for each of the first four years, manufacturers could certify up to 40 percent of one year's production but spread it out over four years in an unequal manner (e.g., 15 percent in the first and second years, and 5 percent in the third and fourth years). Last of all, we request comment on whether the allowance should be available for NOx during the years we a proposing a phase-in for the Tier 4 NOx standards. As proposed, we would not cover NOx during the phase-in years because manufacturers already can certify up to 50 percent of their engines to the Tier 3 NMHC+NOx standards.

Under the proposed Tier 4 program, for engines above 75 horsepower there will be two different groups of engines during the phase-in period. In one group, engines would certify to the applicable Tier 3 NMHC+NOx standard (or Tier 2 standard for engines above 750 horsepower), and would be subject to the ABT restrictions and allowances previously established for those tiers. In the other group, engines would certify to the 0.30 g/bhp-hr NOx standard, and would be subject to the restrictions and allowances in this proposed program. While engines in each group are certified to different standards, we are proposing to allow manufacturers to transfer credits across these two groups of engines with the following adjustment. As proposed, manufacturers could use credits generated during the phase-out of engines subject to the Tier 3 NMHC+NOx standard (or Tier 2 NMHC+NOx standard for engines above 750 horsepower) to average with engines subject to the 0.30 g/bhp-hr NOx standard, but these credits will be subject to a 20 percent discount. In other words, each gram of NMHC+NOx credits from the phase-out engines would be worth 0.8 grams of NOx credits in the new ABT program. The ability to average credits between the two groups of engines will give manufacturers a greater opportunity to gain experience with the low-NOx technologies before they are required to meet the final Tier 4 standards across their full production. (The 20 percent discount would also apply to NMHC+NOx credits generated on less than 75 horsepower engines and used for averaging purposes with the NOx standards for engines greater than 75 horsepower.)

We are proposing the 20 percent discount for two main reasons. First, the discounting addresses the fact that NMHC reductions can provide substantial NMHC+NOx credits, which are then treated as though they were NOx credits. For example, a 2010 model year engine (between 175 and 750 horsepower) emitting at 2.7 g/bhp-hr NOx and 0.3 g/bhp-hr NMHC meets the 3.0 g/bhp-hr NMHC+NOx standard in that year, but gains no credits. In 2011, that engine, equipped with a PM trap to meet the new PM standard, will have very low NMHC emissions because of the trap, an emission reduction already accounted for in our assessment of the air quality benefit of this program. As a result, without substantially redesigning the engine to reduce NOx or NMHC, the manufacturer could garner a windfall of nearly 0.3 g/bhp-hr of NMHC+NOx credit for each of these engines produced. (Engines designed at lower NOx levels than this in 2010 can gain even more credits.) Allowing these NMHC-derived credits to be used undiscounted to offset NOx emissions on the phase-in engines in 2011 (for which each 0.1 g/bhp-hr of margin can make a huge difference in facilitating the design of engines to meet the 0.30 g/bhp-hr NOx standard) would be inappropriate. Second, the discounting would work toward providing a net environmental benefit from the ABT program, such that the more that manufacturers use banked and averaged credits, the greater the potential emission reductions overall.

Some foreign engine manufacturers have commented that it is difficult for them to accurately predict the number of engines that eventually end up in the U.S., especially when they sell to a number of different equipment manufacturers who may import equipment. This would make it difficult for the engine manufacturer to ensure they are complying with the proposed NOx phase-in requirements for engines above 75 horsepower and the proposed PM phase-in requirements for engines above 750 horsepower. Therefore, we are proposing to allow engine manufacturers to demonstrate compliance with the NOx phase in requirements for engines above 75 horsepower and the PM phase in requirements for engines above 750 horsepower by certifying “split” engine families (i.e., an engine family that is split into two equal-sized subfamilies, one that generates a number of credits and one that uses an equal number of credits). In order to facilitate compliance with the proposed standards, we are proposing that this option be available to all engine manufacturers (i.e., both foreign and domestic manufacturers). Manufacturers would be allowed to certify split engine families with FELs no higher than the levels specified in Table VII.A-3. The maximum NOx FEL values specified in Table VII.A-3 were set at the level which would result in NOx ABT credits from engines above the Tier 4 standards offsetting ABT credits from engines below the previously applicable NMHC+NOx standards, including the 20 percent discount for using NMHC+NOx credits on Tier 4 engines. The maximum PM FEL value for engines above 750 horsepower was set at the level halfway between the Tier 2 and proposed Tier 4 PM standard for engines above 750 horsepower. Manufacturers certifying split engine families would exclude those engines from end of the year ABT calculations (and therefore would not need to determine actual U.S. sales of such engine families for ABT credit calculation purposes). Manufacturers certifying split engine families would also exclude those engines from the calculations demonstrating compliance with the phase-in percentage requirements as well.

TABLE VII.A-3 -- MAXIMUM FEL FOR ENGINE FAMILIES CERTIFIED AS "SPLIT" ENGINE FAMILIES

Power Category	Pollutant	Maximum FEL, g/bhp-hr
75 ≤ hp > 175 (56 ≤ kW < 130)	NOx	1.7[a]
175 ≤ hp ≤ 750 (130 ≤ kW < 560)	NOx	1.5
hp > 750 (kW > 560)	NOx	2.3
hp > 750 (kW > 560)	PM	0.08

Notes:
[a] A limit of 2.5 g/bhp-hr would apply under the alternative, reduced phase-in requirement (see Section III.B.1. for a description of the proposed alternative).

We are proposing one additional restriction on the use of credits under the ABT program. For the proposed Tier 4 standards we are proposing that manufacturers may only use credits generated from other Tier 4 engines or from engines certified to the previous tier of standards (i.e., Tier 2 for engines below 50 horsepower, Tier 3 for engines between 50 and 750 horsepower, and Tier 2 engines above 750 horsepower). (As discussed in more detail below, we are proposing slightly different restrictions on the use of previous tier credits for engines between 75 and 175 horsepower.) We currently have a similar provision that prohibits the use of Tier 1 credits to demonstrate Tier 3 compliance, and given the levels of the final Tier 4 standards being proposed today, we believe it is appropriate to apply a similar restriction. Otherwise, we would be concerned about the possibility that credits from engines certified to relatively high standards could be used to significantly delay the implementation of the final Tier 4 program and its benefits.

For reasons explained in Section III.B.1.b. of today's notice, we are proposing unique phase-in requirements for engines between 75 and 175 horsepower in order to ensure appropriate lead time for these engines. Because of these unique phase-in provisions for engines between 75 and 175 horsepower, we are proposing slightly different provisions regarding the use of previous-tier credits. Under this proposal, manufacturers that choose to demonstrate compliance with the proposed phase-in requirements (i.e., 50 percent in 2012 and 2013 and 100 percent in 2014) would be allowed to use Tier 2 NMHC+NOx credits generated by engines above 50 horsepower (along with any other allowable credits) to demonstrate compliance with the Tier 4 standards for engines between 75 and 175 horsepower during model years 2012, 2013 and 2014 only. These Tier 2 credits would be subject to the power rating conversion already established in our ABT program, and to the 20% credit adjustment we are proposing for use of NMHC+NOx credits as NOx credits. Manufacturers that choose to demonstrate compliance with the optional reduced phase-in requirement for engines between 75 and 175 horsepower, would not be allowed to use Tier 2 credits generated by engines above 50 horsepower to demonstrate compliance with the Tier 4 standards. (Use of credits other than banked Tier 2 credits from engines above 50 horsepower would still be allowed, in accordance with other ABT program provisions.) In addition, manufacturers choosing the reduced phase-in option would not be allowed to generate NOx credits from engines in this power category in 2012, 2013, and the first 9 months of 2014, except for use in averaging within this power category (i.e., no banking or trading, or averaging with engines in other power categories would be permitted). This restriction would apply throughout this period even if the reduced phase-in option is exercised during only a portion of this period. We believe that this restriction is important to avoid potential abuse of the added flexibility allowance, considering that larger engine categories will be required to demonstrate substantially greater compliance levels with the 0.30 g/bhp-hr NOx standard several years earlier than engines built under this option.

Under this proposal, we are not proposing any averaging set restrictions for Tier 4 engines. An averaging set is a group of engines, defined by EPA in the regulations, within which manufacturers may use credits under the ABT program. In the current nonroad diesel ABT program, there are averaging set restrictions. The current averaging sets consist of engines less than 25 horsepower and engines greater than or equal to 25 horsepower. The restriction was adopted because of concerns over the ability of manufacturers to generate significant credits from the existing engines and use the credits to delay compliance with the newly adopted standards. (See 63 FR 56977.) We believe the proposed Tier 4 standards are sufficiently protective to limit the ability of manufacturers to generate significant credits from their current engines. In addition, we believe the proposed FEL caps provide sufficient assurance that low-emissions technologies will be introduced in a timely manner. Therefore, under this proposal, averaging would be allowed between all engine power categories without restriction effective with the Tier 4 standards. The averaging set restriction placed on credits generated from Tier 2 and Tier 3 engines would continue to apply if they are used to demonstrate compliance for Tier 4 engines.

As described in Section III.B.1.d.i. of today's notice, we are also proposing a separate PM standard for air-cooled, hand-startable, direct injection engines under 11 horsepower. In order to avoid potential abuse of this standard, engines certified under this proposed requirement would not be allowed to generate credits as part of the ABT program. Credit use by these engines would be allowed. The restriction should be no burden to manufacturers, as it would apply only to those air-cooled, hand-startable, direct injection engines under 11 horsepower that are certified under the special standard, and the production of credit-generating engines would be contrary to the standard's purpose.

The current ABT program contains a restriction on trading credits generated from indirect injection engines greater than 25 horsepower. The restriction was originally adopted because of concerns over the ability of manufacturers to generate significant credits from existing technology engines. (See 63 FR 56977.) Under this proposal, we are not proposing the restriction which prohibits manufacturers from trading credits generated on Tier 4 indirect fuel injection engines greater than 25 horsepower. Based on the certification levels of indirect injection engines, we do not believe there is the potential for manufacturers to generate significant credits from their currently certified engines against the proposed Tier 4 standards. Therefore, we are not proposing to restrict the trading of credits generated on Tier 4 indirect injection engines to other manufacturers. The restriction placed on the trading of credits generated from Tier 2 and Tier 3 indirect injection engines would continue to apply in the Tier 4 timeframe.

We are not proposing to apply a specific discount to Tier 3 PM credits used to demonstrate compliance with the Tier 4 standards. PM credits generated under the Tier 3 standards are based on testing performed over a steady-state test cycle. Under the proposed Tier 4 standards, the test cycle is being supplemented with a transient test (see Section III.C above and VII.F below). Because in-use PM emissions from Tier 3 engines will vary depending on the type of application in which the engine is used (some having higher in-use PM emissions, some having lower in-use PM emissions), the relative "value" of the Tier 3 PM credits in the Tier 4 timeframe will differ. Instead of requiring manufacturers to gather information to estimate the level of in-use PM emissions compared to the PM level of the steady-state test, we believe allowing manufacturers to bring Tier 3 PM credits directly into the Tier 4 time frame without any adjustment is appropriate because it discounts their value for use in the Tier 4 timeframe (since the initial baseline being reduced is probably higher than measured in the Tier 2 test procedure).

3. Should we expand the nonroad ABT program to include credits from retrofit of nonroad engines?

We are considering expanding the scope of the standards by setting voluntary new engine standards applicable to the retrofit of nonroad diesel engines, and allowing these nonroad diesel engines to generate PM and NOx credits available for use by other nonroad diesel engines. This program could achieve greater emission reductions of these pollutants than could otherwise be achieved, in a cost-effective manner. Specifically, we would allow existing in-use nonroad diesel engines that are retrofitted to achieve more stringent levels of emissions than are otherwise required to generate credits available for use in the ABT program by new nonroad engines. Credit-generating engines electing to participate in the program would be considered new nonroad diesel engines, subject to the normal compliance mechanisms applicable to other new nonroad diesel engines. These new nonroad engines could generate credits that could be used in the ABT program for other new nonroad diesel engines. Any such program would also have to ensure that credits are surplus, verifiable, quantifiable, and enforceable. We request comment on whether such a program would be feasible and appropriate for the Tier 4 nonroad standards, and on how such a program might be structured.

We are considering an approach for credit generation based on the use of advanced exhaust emission control technology/engine system combinations that would provide significant emissions reductions. To accomplish this, simple changes that are easy to circumvent accidentally or to defeat intentionally would not be eligible to generate credits, and essentially, only changes involving introduction of post combustion emissions control technology would be eligible. Thus, we would structure the program such that engine recalibration as the sole mechanism to reduce emissions would not be eligible for retrofit credits. Also, as noted, for purposes of a nonroad retrofit ABT program, in order to generate credits, the manufacturer of the nonroad retrofit engine system choosing to participate in the program would accept that the retrofit engine would be considered a new nonroad engine, subject to enforceable standards and normal certification and compliance requirements. We have outlined in a memorandum to the docket our ideas for meeting these objectives, including possible ways to structure the program.[299] This memorandum describes potential procedures for credit generation, credit use, and a number of compliance, implementation, and enforcement measures.

We recognize that expanding the ABT program in this way would introduce new issues and complexities to the nonroad Tier 4 program, and that there are several ways to structure the program. We are seeking comment on whether such an expansion of the ABT program is feasible and appropriate, as well as on the details of how a program could be structured. We have considered and described a possible framework for nonroad retrofit credits in an effort to help commenters provide input. The level of detail provided below and in the memorandum to the docket does not indicate that we have made any decisions on whether nonroad retrofit credits are appropriate for the ABT program or about how the program should function. We invite comment not only on the provisions described below and in the memorandum to the docket, but also on alternative approaches that commenters believe would lead to a better overall program.

We are also seeking comment on the timing of a retrofit credits approach. We believe that if such a program were adopted, credit generation could start in 2004 at the earliest, and request comment on ending the program in the 2015 time frame. We view this as primarily a transitional program which could be most useful in the early years of the nonroad program. Ending the program in 2015 may also ease concerns about long-term impact of such a program on the environment.

We encourage commenters to carefully address all aspects of a nonroad retrofit credits program including its usefulness, feasibility, compliance and enforcement measures, environmental benefits, and potential cost savings. We specifically request comment on the potential for such a program to provide additional emissions reductions than would otherwise be

[299] Memorandum to the Docket, Chris Lieske and Joseph McDonald, EPA, Additional Information on Nonroad Retrofit Engine ABT Credit Concepts, Docket A-2001-28.

obtained and request comment on the potential impacts such provisions would have on emissions reductions associated with the proposed nonroad standards. We are also interested in comments on practical issues and details regarding how the program would operate and be enforced.

a. What would be the environmental impact of allowing ABT nonroad retrofit credits?

We would structure any nonroad credit ABT program in a way that provides greater overall emissions reductions over the life of the group of nonroad engines involved than would otherwise be achieved. These additional overall reductions would be achieved by applying a discount of 20 percent to ABT retrofit credits that are used to meet nonroad standards. The result of applying a discount would be that each ABT retrofit credit generated would translate to less than one nonroad engine credit available for consumption in the nonroad program. For example, a discount of 20 percent would reduce the consumable credits by 20 percent. The discount would provide greater overall net emissions reductions from the use of an ABT retrofit program, and the amount of this environmental benefit would increase with increased use of the program. Also, applying a discount would be consistent with past Agency actions (see additional discussion in the memorandum to the docket noted above).

A discount would be an essential element of the nonroad retrofit credit provisions, since one of our objectives if we promulgated such an expanded ABT program would be to create greater net emission reductions. The absence of a discount would result in no net environmental impact, as the generation of credits would lead to emissions reductions which would be offset by the increase in emissions when the credits were used. A discount would also serve to mitigate the potential for net environmental detriments due to uncertainties in credit calculation and use.

We request comment on whether a discount of 20 percent would be appropriate given the expectation that the discount will generate cost-effective emissions reductions that would otherwise not occur, as well as the more prevalent uncertainties associated with trading credits between nonroad retrofits and new nonroad engines.

b. How would EPA ensure compliance with retrofit emissions standards?

If this program were adopted, we would expect to require the retrofit manufacturer to specify all emissions related maintenance and to list the type of fuel used to certify its retrofit-engine system and whether a particular fuel sulfur level is necessary to meet the standard and to maintain emissions compliance of the retrofit-engine system in-use. If such a fuel is necessary to maintain emissions compliance in-use, EPA would also consider the fuel to be “critical emission related scheduled maintenance” under a retrofit engine program. As a result of such classification, the manufacturer would be required to demonstrate that proper fueling will be performed in-use. Such a demonstration would include a showing that the required fuel is available to, and would be used by, the ultimate consumer or fleet operator receiving the retrofitted engines. Such retrofitted engines would also have to be labeled appropriately to reflect the new engine family and may also require labeling for the type of fuel to be used. In general, we would require the manufacturer to submit a plan for implementing all relevant aspects of the retrofit to ensure proper installation and emissions compliance throughout the useful life period A full discussion of compliance issues and possible compliance provisions, such as recall, in-use testing, useful life, and warranty is provided in the memorandum to the docket, noted above. We request comment on these approaches for ensuring in-use compliance with possible nonroad retrofit emissions standards and requirements.

c. What is the legal authority for a nonroad ABT retrofit program?

Allowing use by new nonroad engines of credits generated by retrofit of in-use nonroad engines is justified legally as an aspect of EPA's standard setting authority. As we envision a program, a retrofit nonroad engine would be considered to be a new nonroad engine when the manufacturer opts into a voluntary retrofit program (if established). Upon such opt-in, this new engine would be subject to enforceable standards under CAA section 213, somewhat similar to opting into the voluntary Blue Sky series standards (see Section VII.E.2). Thus, the generation of credits by nonroad retrofits and their use by new engines subject to Tier 4 would be similar to conventional ABT. Put another way, the generation of credits by retrofitting in-use non-road engines and their subsequent use by new nonroad engines subject to the Tier 4 standards is an averaging program involving emission credits generated by one type of new nonroad engine and used by other new nonroad engines, similar to conventional ABT programs. With a nonroad retrofit credit program, and the emissions reductions associated with it, the overall emission reductions from Tier 4 nonroad engines and nonroad retrofit engines, taken together, would be the greatest achievable considering cost, noise, safety and energy factors, and would also be appropriate after considering those same factors. See also NRDC v. Thomas, 805 F. 2d 410, 425 (D.C. Cir. 1986)(averaging provisions upheld against challenge that they are inconsistent with NCP provisions), and Husqvarna AB v. EPA, 254 F. 3d 195, 202 (D.C. Cir 2001) (averaging, banking, and trading provisions cited as an element supporting EPA's selection of lead time under section 213 (b)). At the same time, we also note that the proposed standards are the greatest achievable (taking all statutory factors into account) and appropriate independent of the nonroad retrofit program, as explained elsewhere in this preamble. [300]

B. Transition Provisions for Equipment Manufacturers

1. Why are we proposing transition provisions for equipment manufacturers?

As EPA developed the 1998 Tier 2/3 standards for nonroad diesel engines, we determined that provisions were needed to avoid unnecessary hardship for equipment manufacturers. The specific concern is the amount of work required and the resulting time needed for equipment

[300] There is one minor exception to this analysis. Retrofits involving use of new nonroad engines as replacement engines in older nonroad equipment would be justified primarily as an aspect of EPA's lead time authority under section 213(d). This is because credits would not be generated from an engine certifying to a more stringent standard, so that the credit is effectively generated by equipment rather than by an engine, i.e. generated by something other than a new non-road engine.

manufacturers to incorporate all of the necessary equipment redesigns into their applications in order to accommodate engines that have been redesigned to meet the new emission standards. We therefore adopted a set of provisions for equipment manufacturers to provide them with reasonable leadtime for the transition process to the newly adopted standards. The program consisted of four major elements: (1) a percent-of-production allowance, (2) a small-volume allowance, (3) availability of hardship relief, and (4) continuance of the allowance to use up existing inventories of engines. See 63 at FR 56977-56978 (Oct. 23, 1998).

Given the level of the proposed Tier 4 standards, we believe that there will be engine design changes comparable in magnitude to those involved during the transition to Tier 2/3. We thus believe that at least some equipment manufacturers will face comparable challenges during the transition to the Tier 4 standards. This is confirmed by comments to EPA by a number of the equipment Small Entity Representatives during the SBREFA process, which indicated that the Tier 2/3 transition provisions were proving beneficial in providing adequate leadtime and urging EPA to adopt comparable provisions in a Tier 4 rule. See Report of the Small Business Advocacy Review Panel, section 8.4.1 (Dec. 23, 2002). Therefore, with a few exceptions described in more detail below, we are proposing to adopt transition provisions for Tier 4 in this notice that are similar to those adopted with the previous Tier 2/3 rulemaking. The following section describes the proposed transition provisions available to equipment manufacturers. (Section VII.C. of today's notice describes all of the proposed provisions that would be available specifically for small businesses.)

Our experience to date with the transition provisions for the Tier 2/3 standards above 50 horsepower is limited. In the one power category where manufacturers have been required to submit information on the number of engines using the allowances (engines between 300 and 600 horsepower), approximately 20 percent of the engines in the category are relying on the allowances in the first year that the Tier 2 standards apply. (For the power categories below 50 horsepower, manufacturers are reporting that there are very few engines using allowances. However, given the level of the Tier 1 standards, we would not expect there to have been much need for equipment redesign to handle Tier 1 engines.) While this information is useful, we do not believe there is enough information available to determine if the level of the existing allowances should be revised for the Tier 4 proposal. For this reason, we are primarily relying on the provisions of the Tier 2/3 equipment manufacturer transition provisions for the Tier 4 proposal. However, as described in more detail below, we are proposing to add notification, reporting, and labeling requirements to the Tier 4 proposal, which are not required in the existing transition provisions for equipment manufacturers. We believe these additional proposed provisions are necessary for EPA to gain a better understanding of the extent to which these provisions will be used and to ensure compliance with the Tier 4 transition provisions. We are also proposing new provisions dealing specifically with foreign equipment manufacturers and the special concerns raised by the use of the transition provisions for equipment imported into the U.S.

As under the existing provisions, equipment manufacturers would not be obligated to use any of these provisions, but all equipment manufacturers would be eligible to do so. Also, as under the existing program, we are proposing that all entities under the control of a common entity, and that meet the definition in the regulations of a nonroad vehicle or nonroad equipment manufacturer contained in the regulations, would have to be considered together for the purposes of applying exemption allowances. This would not only provide certain benefits for the purpose of pooling exemptions, but would also preclude the abuse of the small-volume allowances that would exist if companies could treat each operating unit as a separate equipment manufacturer.

2. What transition provisions are we proposing for equipment manufacturers?

a. Percent-of-Production Allowance

Under the proposed percent-of-production allowance, each equipment manufacturer may install engines not certified to the proposed Tier 4 emission standards in a limited percentage of machines produced for the U.S. market. Equipment manufacturers would need to provided written assurance to the engine manufacturer that such engines are being procured for the purpose of the transition provisions for equipment manufacturers. These engines would instead have to be certified to the standards that would apply in the absence of the Tier 4 standards (i.e., Tier 2 for engines below 50 horsepower, Tier 3 for engines between 50 and 750 horsepower[301], and Tier 2 for engines above 750 horsepower). This percentage would apply separately to each of the proposed Tier 4 power categories (engines below 25 horsepower, engines between 25 and 75 horsepower, engines between 75 and 175 horsepower, engines between 175 and 750 horsepower, and engines above 750 horsepower) and is expressed as a cumulative percentage of 80 percent over the seven years beginning when the Tier 4 standards first apply in a category. No exemptions would be allowed after the seventh year. For example, an equipment manufacturer could install engines certified to the Tier 3 standards in 40 percent of its entire 2011 production of nonroad equipment that use engines rated between 175 and 750 horsepower, 30 percent of its entire 2012 production in this horsepower category, and 10 percent of its entire 2013 production in this horsepower category. (During the transitional period for the Tier 4 standards, the fifty percent of engines that would be allowed to certify to the previous tier NOx standard but meet the Tier 4 PM standard would be considered as Tier 4-compliant engines for the purpose of the equipment manufacturer transition provisions.) If the same manufacturer were to produce equipment using engines rated above 750 horsepower, a separate cumulative percentage allowance of 80 percent would apply to these machines during the seven years beginning in 2011. This proposed percent-of-production allowance is almost identical to the percent-of-production allowance adopted in the October 1998 final rule, the difference being, as explained earlier, that we are proposing to have fewer power categories associated with the proposed Tier 4 standards.

The proposed 80 percent exemption allowance, were it to be used to its maximum extent by all equipment manufacturers, would bring about the introduction of cleaner engines several months later than would have occurred if the new standards were to be implemented on their effective dates. However, the equipment manufacturer flexibility program has been integrated with the standard-setting process from the initial development of this proposal, and as such we

[301] Under this proposal, for engines between 50 and 75 horsepower, the NMHC+NOx standard that would apply in Tier 4 is the same as the existing Tier 3 NMHC+NOx standard.

believe it is a key factor in assuring that there is sufficient lead time to initiate the Tier 4 standards according to the proposed schedule.[302]

Machines that use engines built before the effective date of the proposed Tier 4 standards would not be included in an equipment manufacturer's percent of production calculations under this allowance. Machines that use engines certified to the previous tier of standards under our Small Business provisions (as described in Section VII.C. of this proposal) would not be included in an equipment manufacturer's percent of production calculations under this allowance. All engines certified to the Tier 4 standards, including those engines that produce emissions at higher levels than the standards, but for which an engine manufacturer uses ABT credits to demonstrate compliance, would count as Tier 4 complying engines and would not be included in an equipment manufacturer's percent of production calculations. As noted earlier, engines that meet the proposed Tier 4 PM standards but are allowed to meet the Tier 3 NMHC+NOx standards during the phase-in period would also count as Tier 4 complying engines and would not be included in an equipment manufacturer's percent of production calculations. And, as also noted earlier, all engines used under the percent-of-production allowance would have to certify to the standards that would be in effect in the absence of the Tier 4 standards (i.e., the Tier 3 standards for engines between 50 and 750 horsepower and the Tier 2 standards for engines below 50 horsepower and above 750 horsepower).

The choice of a cumulative percent allowance of 80 percent is based on our best estimate of the degree of reasonable leadtime needed by equipment manufacturers. We believe the 80 percent allowance responds to the need for flexibility identified by equipment manufacturers, while ensuring a significant level of emission reductions in the early years of the proposed program.

We are also proposing to allow manufacturers to start using a limited number of the new Tier 4 flexibilities once the seven-year period for the existing Tier 2/Tier 3 program expires (and so continue producing engines meeting Tier 1 or Tier 2 standards). In this way, a manufacturer could potentially continue exempting the most difficult applications once the seven-year period of the current Tier 2/3 flexibility provisions is finished. (Under the existing transition program for equipment manufacturers, any unused allowances expire after the seven year period. We are not reopening this provision with this proposal.) However, opting to start using Tier 4 allowances once the seven-year period from the current Tier 2/Tier 3 program expires would reduce the available percent of production exemptions available from the Tier 4 standards. We are proposing that equipment manufacturers may use up to a total of 10 percent of their Tier 4 allowances prior

[302] For emissions modeling purposes, we have assumed that manufacturers take full advantage of the existing allowances under the transition program for equipment manufacturers in establishing the emissions baseline. This assumption is based on information provided to us by engine manufacturers for model year 2001, which shows that approximately 20 percent of the engines in the 300-600 horsepower category are relying on the allowances in the first year that the Tier 2 standards apply. In modeling the Tier 4 program, because the program will not take effect for many years and it is not possible to accurately forecast use of the proposed transition program for equipment manufacturers and to assess costs in a conservative manner, we have assumed that all engines will meet the Tier 4 standards in the timeframe proposed. As discussed in Section V.C., this is consistent with our cost analysis, which assumes no use of the proposed transition program for equipment manufacturers.

to the effective date of the proposed Tier 4 standards. (The early use of Tier 4 allowances would be allowed in each Tier 4 power category.) This percentage of equipment utilizing the early Tier 4 allowances would be subtracted from the proposed Tier 4 allowance of 80 percent for the appropriate power category, resulting in fewer allowances once the Tier 4 standards take effect. For example, if an equipment manufacturer used the maximum amount of early Tier 4 allowances of 10 percent, then the manufacturer would have a cumulative total of 70 percent remaining when the Tier 4 standards take effect (i.e., 80 percent production allowance minus 10 percent). We are also requesting comment on requiring equipment manufacturers to take a two-for-one loss of Tier 4 allowances for each allowance used prior to the Tier 4 effective date. This would reduce the number of overall engines that could be exempted under the Tier 4 allowance program and result in greater environmental benefits than would be realized if manufacturers used all of the Tier 4 allowances in the Tier 4 timeframe.

We view this proposed provision on early use of Tier 4 allowances as providing reasonable leadtime for introducing Tier 4 engines, since it should result in earlier introduction of Tier 4-compliant engines (assuming that the 80% allowance would otherwise be utilized) with resulting net environmental benefit (notwithstanding longer utilization of earlier Tier engines, due to the stringency of the Tier 4 standards) and should do so at net reduction in cost by providing cost savings for the engines that have used the Tier 4 allowances early. As discussed above, once the Tier 4 implementation model year begins, engines which use the transition provision allowances must be certified to the standards that would apply in the absence of the Tier 4 standards.

b. Small-Volume Allowance

The percent-of-production approach described above may provide little benefit to businesses focused on a small number of equipment models. Therefore we are proposing to allow any equipment manufacturer to exceed the percent-of-production allowances described above during the same seven year period, provided the manufacturer limits the number of exempted engines to 700 total over the seven years, and to 200 in any one year. As noted earlier, equipment manufacturers would need to provided written assurance to the engine manufacturer when it purchases engines under the transition provisions for equipment manufacturers. The limit of 700 exempted engines would apply separately to each of the proposed Tier 4 power categories (engines below 25 horsepower, engine between 25 and 75 horsepower, engines between 75 and 175 horsepower, engines between 175 and 750 horsepower, and engines above 750 horsepower). In addition, manufacturers making use of this provision must limit exempted engines to a single engine family in each Tier 4 power category.

As with the proposed percent-of-production allowance, machines that use engines built before the effective date of the proposed Tier 4 standards would not be included in an equipment manufacturer's count of engines under the small-volume allowance. Similarly, machines that use engines certified to the previous tier of standards under our Small Business provisions (as described in Section VII.C. of this proposal) would not be included in an equipment manufacturer's count of engines under the small-volume allowance. All engines certified to the Tier 4 standards, including those that produce emissions at higher levels than the standards but for which an engine manufacturer uses ABT credits to demonstrate compliance, would be considered as Tier 4 complying engines and would not be included in an equipment manufacturer's count of engines under the small-volume allowance. Engines that meet the proposed Tier 4 PM standards but are allowed to meet the Tier 3 NMHC+NOx standards during the phase-in period would also be considered as Tier 4 complying engines and would not be included in an equipment manufacturer's count of engines under the small-volume allowance. All engines used under the small-volume allowance would have to certify to the standards that would be in effect in the absence of the Tier 4 standards (i.e., the Tier 3 standards for engines between 50 and 750 horsepower and the Tier 2 standards for engines below 50 horsepower and above 750 horsepower).

In discussions regarding the current small-volume allowance, some manufacturers expressed the desire to be able to exempt engines from more than one engine family, but still fall under the number of exempted engine limit. (Under the current rules, although equipment manufacturers are allowed to exempt up to 700 units over seven years, they must all use the same engine family. In many cases, a manufacturer's largest sales volume model does not even sell 700 units over seven years. As a result, the maximum number of units a manufacturer can exempt under the small-volume allowance is less than the 700 unit limit.) We are concerned, however, that allowing manufacturers to exempt engines in more than one family, but retaining the current 700-unit allowance, could lead to significantly higher numbers of engines being exempted from the Tier 4 program.

Using data of equipment sales by equipment manufacturers that qualify as small businesses under Small Business Administration (SBA) guidelines, we have analyzed the effects of a small-volume allowance program that would set an exempted engine allowance lower than 700 units over seven years but allow manufacturers to exempt engines from more than one engine family. Based on sales information for small businesses, we believe we could revise the small-volume allowance program to include lower caps and allow manufacturers to exempt more than one engine family while still keeping the total number of engines eligible for the allowance at roughly the same overall level as the 700-unit program described above.[303] Such a program would in general provide sufficient leadtime for equipment manufacturers, allowing them to temporarily exempt greater numbers of equipment models from the proposed Tier 4 standards, but, as noted above, keeping the total number of engines eligible for the allowance at roughly the same overall level as the existing program would allow (and so not allow more leadtime than necessary). Based on our analysis, the small-volume allowance program could be revised to allow equipment manufacturers to exempt 525 machines over seven years (with a maximum of 150 in any given year) for each of the three power categories below 175 horsepower, and 350 machines over seven years (with a maximum of 100 in any given year) for the two power categories above 175 horsepower. Concurrent with the revised caps, manufacturers would be allowed to exempt engines from more than one engine family under the small-volume allowance program. Table VII.B-1 compares the proposed small-volume allowance program to the variation described in this paragraph.

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[303] "Analysis of Small Volume Equipment Manufacturer Flexibilities," EPA memo from Phil Carlson to Docket A-2001-28.

TABLE VII.B-1 -- SMALL-VOLUME ALLOWANCE PROGRAM COMPARISON

	Engines exempted over 7 years	Maximum exempted engines in one year	Single Engine Family Restriction?
Proposed program	- 700 for each power category.	200	- Yes
Variation under consideration	- 525 for power categories <175 hp. - 350 for power categories >175 hp.	100	- No

We request comment on adopting a small-volume allowance program with the lower caps noted above that allows manufacturers to exempt more than one engine family in each power category. We specifically request comment on allowing equipment manufacturers to choose between the two small-volume allowance programs described above. Alternatively, we request comment on whether we should replace the current program (which allows 700 units over seven years with a one engine family restriction) with this revised small-volume allowance program (which would allow fewer units over seven years but without the single engine family restriction). Our analysis of small businesses noted above did show that there were a very limited number of companies that could potentially get fewer total allowances under a revised program with the lower caps compared to the existing program (i.e., a company that sells an equipment model that utilizes one engine family whose sales over a seven year period are above the revised limits noted above but less than 700). Allowing an equipment manufacturer to choose between the two programs would help to ensure that manufacturers are able to retain the current level of flexibility they have under the current program.

Because we are proposing fewer power categories for the Tier 4 standards, the proposed equipment flexibility program is designed to reflect those changes. Therefore, under the proposed small-volume allowance, the specified unit allowances will apply separately to each of the five power categories being proposed for the Tier 4 standards.

As noted earlier, we are also proposing to allow manufacturers to start using a limited number of the new Tier 4 flexibilities once the seven-year period for the existing Tier 2/Tier 3 program expires (and so continue producing engines meeting Tier 1 or Tier 2 standards). Under the proposed small-volume allowance, any engines used by the manufacturer prior to Tier 4 would be subtracted from the proposed 700 unit allowance (for the appropriate Tier 4 power category), resulting in fewer allowances once the Tier 4 standards take effect. As with the proposed percent-of-production allowance, we are proposing to limit the number of Tier 4 small-volume allowances that can be used prior to the effective dates of the Tier 4 standards to a total of 100 units in each of the Tier 4 power categories. We are taking comment on requiring equipment manufacturers to take a two-for-one loss of Tier 4 small-volume allowances for each allowance used prior to the Tier 4 effective date. As explained above, we view this proposal as providing reasonable leadtime for introduction of Tier 4 engines by providing the possibility of earlier introduction of such engines with a net cost savings.

c. Hardship Relief Provision

We are proposing to extend the availability of the "hardship relief provision" with the Tier 4 transition provisions for equipment manufacturers. Under the proposal, an equipment manufacturer that does not make its own engines could obtain limited additional relief by providing evidence that, despite its best efforts, it cannot meet the implementation dates, even with the proposed equipment flexibility program provisions outlined above. Such a situation might occur if an engine supplier without a major business interest in the equipment manufacturer were to change or drop an engine model very late in the implementation process. As with other equipment manufacturer transition provisions, the equipment Small Entity Representatives indicated that the availability this allowance was useful to them in the transition to the Tier 2/3 standards, and they urged that it be continued in any Tier 4 rule. Report of the Small Business Advocacy Panel, section 8.4.1.

Applications for hardship relief would have to be made in writing, and would need to be submitted before the earliest date of noncompliance. The application would also have to include evidence that failure to comply was not the fault of the equipment manufacturer (such as a supply contract broken by the engine supplier), and would need to include evidence that serious economic hardship to the company would result if relief is not granted. We would work with the applicant to ensure that all other remedies available under the flexibility provisions were exhausted before granting additional relief, if appropriate, and would limit the period of relief to no more than one year. Applications for hardship relief generally will only be accepted during the first year after the effective date of an applicable new emission standard.

The Agency expects this provision would be rarely used. This expectation has been supported by our initial experience with the Tier 2 standards in which only one equipment manufacturer has applied under the hardship relief provisions. Requests for hardship relief would be evaluated by EPA on a case-by-case basis, and may require, as a condition of granting the applications, that the equipment manufacturer agree (in writing) to some appropriate measure to recover the lost environmental benefit.

d. Existing Inventory Allowance

The current program for nonroad diesel engines includes a provision for equipment manufacturers to continue to use engines built prior to the effective date of new standards, until the older engine inventories are depleted. It also prohibits stockpiling of previous tier engines. We are proposing to extend these provisions as manufacturers transition to the standards contained in this proposal. We are also proposing to extend the existing provision that provides an exception to the applicable compliance regulations for the sale of replacement engines. In proposing to extend this provision, we are requiring that engines built to replace certified engines be identical in all material respects to an engine of a previously certified configuration that is of the same or later model year as the engine being replaced. The term "identical in all material respects" would allow for minor differences that would not reasonably be expected to affect emissions.

3. What are the recordkeeping, notification, reporting, and labeling requirements associated with the equipment manufacturer transition provisions?

a. Recordkeeping Requirements for Engine and Equipment Manufacturers

We are proposing to extend the recordkeeping requirements from the current equipment manufacturer transition program. Under the proposed requirements, engine manufacturers would be allowed to continue to build and sell previous tier engines needed to meet the market demand created by the equipment manufacturer flexibility program, provided they receive written assurance from the engine purchasers that such engines are being procured for this purpose. We are proposing that engine manufacturers would be required to keep copies of the written assurance from the engine purchasers for at least five full years after the final year in which allowances are available for each power category.

Equipment manufacturers choosing to take advantage of the proposed Tier 4 allowances would be required to: (1) keep records of the production of all pieces of equipment excepted under the allowance provisions for at least five full years after the final year in which allowances are available for each power category; (2) include in such records the serial and model numbers and dates of production of equipment and installed engines, and the rated power of each engine, (3) calculate annually the number and percentage of equipment made under these transition provisions to verify compliance that the allowances have not been exceeded in each power category; and (4) make these records available to EPA upon request.

b. Notification Requirements for Equipment Manufacturers

We are also proposing some new notification requirements for equipment manufacturers with the Tier 4 program. Under this proposal, equipment manufacturers wishing to participate in the Tier 4 transition provisions would be required to notify EPA prior to their use of the Tier 4 transition provisions. Equipment manufacturers would be required to submit their notification before the first calendar year in which they intend to use the transition provisions. We believe that prior notification will not be a significant burden to the equipment manufacturer, but will greatly enhance our ability to ensure compliance. Indeed, EPA believes that in order for an equipment manufacturer to properly use either of the allowances provided, it would already have the information required in the notification. Thus we are not requiring additional planning or information gathering beyond that which the equipment manufacturer must already be doing in order to ensure its compliance with the regulations. Under the proposed notification requirements, each equipment manufacturer would be required to notify EPA in writing and provide the following information:

(1) the nonroad equipment manufacturer’s name, address, and contact person’s name, phone number;
(2) the allowance program that the nonroad equipment manufacturer intends to use by power category;

(3) the calendar years in which the nonroad equipment manufacturer intends to use the exception;

(4) an estimation of the number of engines to be exempted under the transition provisions by power category;

(5) the name and address of the engine manufacturer from whom the equipment manufacturer intends to obtain exempted engines; and

(6) identification of the equipment manufacturer's prior use of Tier 2/3 transition provisions.

EPA is requesting comment on whether the notification provisions should also apply to the current Tier 2/Tier 3 transition program, and if so, how these provisions should be phased in for equipment manufacturers using the current Tier 2/Tier 3 transition provisions. EPA believes such a notification provision could be implemented as soon as 2005 and requests comments on the appropriate start date should we adopt such a notification provision for equipment manufacturers for the Tier 2/Tier 3 transition program.

c. Reporting Requirements for Engine and Equipment Manufacturers

As with the current program, engine manufacturers who participate in the proposed Tier 4 program would be required to annually submit information on the number of such engines produced and to whom the engines are provided, in order to help us monitor compliance with the program and prevent abuse of the program.

We are proposing new reporting requirement for equipment manufacturers participating in the Tier 4 equipment manufacturer transition provisions. Under this proposal, equipment manufacturers participating in the program would be required to submit an annual written report to EPA that calculates its annual number of exempted engines under the transition provisions by power category in the previous year. Equipment manufacturers using the percent of production allowance, would also have to calculate the percent of production the exempted engines represented for the appropriate year. Each report would include a cumulative calculation (both total number and, if appropriate, the percent of production) for all years the equipment manufacturer has used the transition provisions for each of the proposed Tier 4 power categories. In order to ease the reporting burden on equipment manufacturers, EPA intends to work with the manufacturers to develop an electronic means for submitting information to EPA.

EPA is requesting comment on whether these reporting requirements should also apply to the current Tier 2/Tier 3 transition program, and if so, how these provisions should be phased in for equipment manufacturers using the current Tier 2/Tier 3 transition provisions. Because equipment manufacturers are already required to keep the information we would require under the reporting requirements described above, we believe such a reporting requirement could be implemented to cover exempted engines produced in the 2005 model year. We request comments on the appropriate start date should we adopt such reporting requirements for equipment manufacturers for the Tier 2/Tier 3 transition program.

d. Labeling Requirements for Engine and Equipment Manufacturers

Engine manufacturers are currently required to label their certified engines with a label that contains a variety of information. Under this proposal, we are proposing that engine manufacturers would be required to identify on the engine label if the engine is exempted under the Tier 4 transition program. In addition, equipment manufacturers would be required to apply a label to the engine or piece of equipment that identifies the equipment as using an engine produced under the Tier 4 transition program for equipment manufacturers. These proposed labeling requirements would allow EPA to easily identify the exempted engines and equipment, verify which equipment manufacturers are using these exceptions, and more easily monitor compliance with the transition provisions. Labeling of the equipment could also help U.S. Customs to quickly identify equipment being imported using the exemptions for equipment manufacturers.

EPA is requesting comment on whether these labeling requirements should also apply to the current Tier 2/Tier 3 transition program, and if so, how these provisions should be phased in for engine manufacturers and equipment manufacturers. Due to limited impact of such a labeling requirement, we believe such a requirement could be implemented to cover model year 2005 engines and equipment using those engines. We request comments on the appropriate start date should we adopt such labeling requirements for engine manufacturers and equipment manufacturers for the Tier 2/Tier 3 transition program.

4. What are the proposed requirements associated with use of transition provisions for equipment produced by foreign manufacturers?

Under the current regulations, importers are treated as equipment manufacturers and are each allowed the full allowance under the transition provisions. Therefore, under the current provisions, importers of equipment from a foreign equipment manufacturer could as a group import more excepted equipment from that foreign manufacturer than 80% of that manufacturer’s production for the US market or more than the small volume allowances identified in the transition provisions. Therefore, the current regulation creates a potentially significant disparity between the treatment of foreign and domestic equipment manufacturers. EPA did not intend this outcome, and does not believe it is needed to provide reasonable leadtime to foreign equipment manufacturers.

Under this proposal, only the nonroad equipment manufacturer that is most responsible for the manufacturing and assembling process would qualify for the allowances or other relief provided under the Tier 4 transition provisions. Foreign equipment manufacturers who comply with the compliance related provisions discussed below would receive the same allowances and other transition provisions as domestic manufacturers. Foreign equipment manufacturers who do not comply with the compliance related provisions discussed below would not receive allowances. Importers that have little involvement in the manufacturing and assembling of the equipment would not receive any allowances or other transition relief directly, but could import exempt equipment if it is covered by an allowance or transition provision associated with a foreign equipment manufacturer. This would allow transition allowances and other provisions to be used by foreign equipment manufacturers in the same way as domestic equipment manufacturers, while avoiding the potential for importers unnecessarily using allowances. For the purposes of this proposal, a foreign equipment manufacturer would include any equipment manufacturer that produces equipment outside of the United States that is eventually sold in the United States.

All foreign nonroad equipment manufacturers wishing to use the transition provisions would have to comply with all requirements of the regulation discussed above including: notification, recordkeeping, reporting and labeling. Along with the equipment manufacturer's notification described earlier, a foreign nonroad equipment manufacturer would have to comply with various compliance related provisions similar to those adopted in several fuel regulations relating to foreign refiners.[304] As part of the notification, the foreign nonroad equipment manufacturer would have to:

1) Agree to provide EPA with full, complete and immediate access to conduct inspections and audits;
2) Name an agent in the District of Columbia for service of process;
3) Agree that any enforcement action related to these provisions would be governed by the Clean Air Act;
4) Submit to the substantive and procedural laws of the United States;
5) Agree to additional jurisdictional provisions;
6) Agree that the foreign nonroad equipment manufacturer will not seek to detain or to impose civil or criminal remedies against EPA inspectors or auditors for actions performed within the scope of EPA employment related to the provisions of this program;
7) Agree that the foreign nonroad equipment manufacturer becomes subject to the full operation of the administrative and judicial enforcement powers and provisions of the United States without limitation based on sovereign immunity; and
8) Submit all reports or other documents in the English language, or include an English language translation.

In addition to these proposed requirements, we are requesting comment on requiring foreign equipment manufacturers that participate in the transition program to comply with a bond requirement for engines imported into the U.S. We describe a bond program below which we believe could be an important tool to ensure that foreign equipment manufacturers are subject to the same level of enforcement as domestic equipment manufacturers. We believe a bonding requirement for the foreign equipment manufacturer is an important enforcement tool in order to ensure that EPA has the ability to collect any judgements assessed against a foreign equipment manufacturer for violations of these transition provisions. We request comments on all aspects of the specific program we describe here, but also on alternative measures which would achieve the

[304] See, for example, 40 CFR 80.410 concerning provisions for foreign refiners with individual gasoline sulfur baselines.

same goal. A memo has been placed in the docket for today's notice that contains draft regulatory language that would apply if we adopted a bonding requirement as discussed in this section.[305]

Under a bond program, the participating foreign equipment manufacturer would have to obtain annually a bond in the proper amount that is payable to satisfy United States judicial judgments that results from administrative or judicial enforcement actions for conduct in violation of the Clean Air Act. The foreign equipment manufacturer would have three options for complying with the bonding requirement. The foreign equipment manufacturer could:

1) post a bond by paying the amount of the bond to the Treasurer of the United States;
2) obtain a bond in the proper amount from a third party surety agent, provided EPA agrees in advance as to the third party and the nature of the surety agreement; or
3) obtain an EPA waiver from the bonding requirement, if the foreign equipment manufacturer can show that it has assets of an appropriate value in the United States.

EPA expects the third bond option to address instances where an equipment manufacturer produces equipment outside the United States containing flexibility engines, but also has facilities (and thus significant assets) inside the United States. Under this third option, such a manufacturer could apply to the EPA for a waiver of the bonding requirement.

Since EPA's concerns of compliance will relate to the nature and tier of engine used in the transition equipment, we believe the bond value should be related to the value of the engine used. Therefore, we are requesting comment on a value of the bond set at a level designed to represent approximately 10% of the cost of the engine for each piece of transition equipment produced for import into the United States under this program. So that manufacturers have certainty regarding the bond amounts and so that there isn't a need for extensive data submittals and evaluation between EPA and the manufacturer, we request comment on EPA specifying in this rulemaking the estimated average cost for a Tier 4 engine on which the bond would be based. For example, we believe cost estimates on the order of those contained in Table 10.3-3 of the draft RIA may be an appropriate basis. Under this approach, transition equipment using engines in the less than 25 horsepower category would require a bond of $150 per piece of equipment (10 percent of $1,500), equipment using engines in the 25-50 horsepower range would require a bond of $250 per piece of equipment (10 percent of $2,500), etc. We also request comment on whether 10 percent is a sufficient value for the bond or whether higher values, such as 50 percent, or lower values are more appropriate.

Finally, if a foreign equipment manufacturer's bond is used to satisfy a judgment, the foreign equipment manufacturer would then be required to increase the bond to cover the amount used within 90 days of the date the bond is used.

In addition to the foreign equipment manufacturer requirements discussed above, EPA also proposes to require importers of exempted equipment from a complying foreign equipment

[305] "Potential Bond Regulations for Foreign Equipment Manufacturers Under the Tier 4 Nonroad Diesel Proposal," EPA memorandum from Leslie Kirby-Miles, U.S. EPA/OECA to Docket A-2001-28.

manufacturer to comply with certain provisions. EPA believes these importer provisions are essential to EPA's ability to monitor compliance with the transition provisions. EPA proposes that the regulations would require each importer to notify EPA prior to their initial importation of equipment exempted under the Tier 4 transition provisions. Importers would be required to submit their notification prior to the first calendar year in which they intend to import exempted equipment from a complying foreign equipment manufacturer under the transition provisions. The importer's notification would need to include the following information:

1) the name and address of importer (and any parent company);
2) the name and address of the manufacturers of the exempted equipment and engines the importer expects to import;
3) number of exempted equipment the importer expects to import for each year broken down by equipment manufacturer and power category; and
4) the importer's use of the transition provisions in prior years (number of flexibility engines imported in a particular year, under what power category, and the names of the equipment and engine manufacturers).

In addition, EPA is proposing that any importer electing to import to the United States exempted equipment from a complying foreign equipment manufacturer would have to submit annual reports to EPA. The annual report would include the number of exempted equipment the importer actually imported to the United States in the previous calendar year; and the identification of the equipment manufacturers and engine manufacturers whose exempted equipment/engines were imported.

C. Engine and Equipment Small Business Provisions (SBREFA)

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute, unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions. Since EPA believes that the proposed rule may have a significant economic impact on small businesses, we intend to prepare a regulatory flexibility analysis as part of this rulemaking, and have prepared an initial regulatory flexibility analysis (IRFA) pursuant to section 603 of the RFA which is part of the record for this proposal.

Under section 609(b) of the RFA, a Small Business Advocacy Review Panel (SBAR Panel or Panel) is required to be convened prior to publication of an IRFA that an agency may be required to prepare under the RFA. Section 609(b) directs the Panel to, through outreach with small entity representatives (SERs), report on the comments of the SERs and make findings on issues related to identified elements of an IRFA under section 603 of the RFA (see Section X.C of this preamble for more discussion on the elements of an IRFA). The purpose of the Panel is to gather information to identify potential impacts on small businesses and to develop options to mitigate these concerns. At the completion of the SBAR Panel process, the Panel is required to prepare a Final Panel Report. This report includes background information on the proposed rule being developed, information on the types of small entities that would be subject to the proposed rule, a description of efforts made to obtain the advice and recommendations of representatives of those small entities, and a summary of the comments that have been received to date from those representatives. Once completed, the Panel report is provided to the agency issuing the proposed rule and included in the rulemaking record. The report provides the Panel and the Agency with an opportunity to identify and explore potential ways of shaping the proposed rule to minimize the burden of the rule on small entities while achieving the rule's purposes and when consistent with Clean Air Act statutory requirements.

EPA has approached this process with care and diligence. To identify representatives of small businesses for this process, we used the definitions provided by the Small Business Administration (SBA) for manufacturers of nonroad diesel engines and vehicles. The categories of small entities in the nonroad diesel sector that will potentially be affected by this rulemaking are defined in the following table:

Industry	**Defined as small entity by SBA if:**	**Major SIC Codes**
Engine manufacturers	Less than 1,000 employees	Major Group 35
Equipment manufacturers:		
- construction equipment	Less than 750 employees	Major Group 35
- industrial truck manufacturers (i.e. forklifts)	Less than 750 employees	Major Group 35
- all other nonroad equipment manufacturers	Less than 500 employees	Major Group 35

One small engine manufacturer and 5 small equipment manufacturers agreed to serve as Small Entity Representatives (SERs) throughout the SBAR Panel process for this proposal. These companies represented the nonroad market well, as the group of SERs consisted of businesses that manufacture various types of nonroad diesel equipment.

The following are the provisions recommended by the SBAR Panel, including both the provisions that we, EPA, are proposing and those on which we are requesting comment. As described in Section VII.B above, there are other provisions that apply to all equipment manufacturers; however, most of the discussion in this section is geared to small entities only. We request comment on all aspects of both the provisions recommended by the Panel and on those that we are proposing in today's action.

1. Nonroad Diesel Small Engine Manufacturers

a. Lead Time Transition Provisions for Small Engine Manufacturers

i. What the Panel Recommended

The transition provisions recommended by the SBAR Panel for engines produced or imported by small entities are listed below. For all of the provisions, the Panel recommended that small engine manufacturers and small importers must have certified engines in model year 2002 or earlier in order to take advantage of these provisions. Each manufacturer would be limited to 2,500 units per year as this number allows for some market growth. The Panel recommended these stipulations in order to prohibit the misuse of the transition provisions as a tool to enter the nonroad diesel market or to gain unfair market position relative to other manufacturers.

Currently, certified nonroad diesel engines produced by small manufacturers all have a horsepower rating of 80 or less. The transition provisions that the Panel considered were dependent upon what approach, or approaches, were proposed for the rulemaking.

- For an approach with two phases of standards:
  - an engine manufacturer could skip the first phase and comply on time with the second; or,
  - a manufacturer could delay compliance with each phase of standards for three years.

- For an approach that entails only one phase of standards, the manufacturer could opt to delay compliance. It was recommended that the length of the delay be three years; however the Panel suggested that we request comment on whether this delay period should be two, three, or four years. Each delay would be pollutant specific (i.e., the delay would apply to each pollutant as it is phased in).

The Panel believed that these options could offer an opportunity to reduce the burden on small manufacturers while at the same time meet the regulatory goals of the Agency. The Panel further believed that these options would not put small manufacturers at a significant disadvantage as they would be in compliance with the Tier 4 standards in the long run and the options would give them more lead time to comply. The Panel also felt that a complete exemption from the upcoming standards (even assuming that such an exemption could be justified legally) would put these manufacturers at a competitive disadvantage as the rest of the market would be producing compliant engines and eventually there would not be equipment designed to accommodate their engines.

ii. What EPA is Proposing

Due to the structure of the standards and their timing as discussed in Section III, EPA is proposing transition provisions for small engine manufacturers which encompass both approaches recommended by the Panel, with the inclusion of the 2,500 unit limit (as suggested by the Panel) for each manufacturer.

- First, with regard to PM:
  - Engines under 25 hp and those between 75 and 175 hp have only one standard so the manufacturer could delay compliance with these standards for up to three years. Based on available data, we believe that there are no small manufacturers of nonroad diesel engines above 175 hp.
  - For engines between 50 and 75 hp, EPA is proposing a one phase program with the option to delay compliance for one year if interim standards are met. For this power category we are treating the PM standard as a two phase standard with the stipulation that small manufacturers cannot use PM credits to meet the interim standard. Furthermore, if a small manufacturer elects the optional approach to the standard (elects to skip the interim standard), no further relief will be provided.
- Second, with regard to NOx:
  - There is no change in the NOx standard for engines under 25 hp and those between 50 and 75 hp. For these two power bands EPA is proposing no special provisions.
  - For engines in the 25-50 hp and the 75-175 hp categories we are proposing a three year delay in the program consistent with the one-phase approach recommendation above. Based on available data, we believe that there are no small manufacturers of nonroad diesel engines above 175 hp.

b. Hardship Provisions for Small Engine Manufacturers

i. What the Panel Recommended

The Panel recommended two types of hardship provisions for small engine manufacturers. These provisions are:

- For the case of a catastrophic event, or other extreme unforseen circumstances, beyond the control of the manufacturer that could not have been avoided with reasonable discretion (i.e. fire, tornado, supplier not fulfilling contract, etc.); and
- For the case where a manufacturer has taken all reasonable business, technical, and economic steps to comply but cannot.

Either hardship relief provision would provide lead time for up to 2 years, and a manufacturer would have to demonstrate to EPA's satisfaction that failure to sell the noncompliant engines would jeopardize the company's solvency, EPA may also require that the manufacturer make up the lost environmental benefit.

ii. What EPA is Proposing

EPA is proposing to adopt the Panel recommendations for hardship provisions for small engine manufacturers. While perhaps ultimately not necessary given the phase-in schedule discussed above, such provisions provide a useful safety valve in the event of unforeseen extreme hardship.

c. Other Small Engine Manufacturer Issues

i. What the Panel Recommended

The Panel also recommended that an ABT program be included as part of the overall rulemaking program. In addition, the Panel suggested that EPA take comment on including specific ABT provisions for small engine manufacturers.

ii. What EPA is Proposing

As discussed above, an ABT program has been included in the overall program in this rule proposal. ABT is being proposed in today's action as it is intended to enhance the flexibility offered to engine manufacturers that will be of assistance in making the transition to meet the stringent standards proposed in today's rules in the leadtime proposed. As noted in Section VII.A, EPA is proposing to retain the basic structure of the current nonroad diesel ABT program, though a number of changes (which will help to accommodate implementation of the proposed emission standards) are being proposed today.

Though the Panel recommended small engine manufacturer-specific ABT provisions, such provisions are not being included in this proposal. EPA does not believe it would be appropriate to provide a different ABT program for small engine manufacturers, especially given the provisions mentioned above. Discussions during the SBAR process indicated that small volume manufacturers would need extra time to comply due to cost and personnel constraints, and there is little reason to believe that small manufacturer specific ABT provisions could create an incentive to accelerate compliance. Small manufacturers would of course be able to participate in the general ABT program, which EPA believes will provide sufficient lead time for small entities.

2. Nonroad Diesel Small Equipment Manufacturers

a. Transition Provisions for Small Equipment Manufacturers

i. What the Panel Recommended

The Panel recommended that EPA adopt the transition provisions described below for small manufacturers and small importers of nonroad diesel equipment. These transition provisions are similar to those in the Tier 2/3 rule (see 89.102). The recommended transition provisions are as follows:

- Percent-of-Production Allowance: Over a seven model year period, equipment manufacturers may install engines not certified to the new emission standards in an amount of equipment equivalent to 80 percent of one year's production. This is to be implemented by power category with the average determined over the period in which the flexibility is used.

- Small Volume Allowance: A manufacturer may exceed the 80 percent allowance in seven years as described above, provided that the previous Tier engine use does not exceed 700 total over seven years, and 200 in any given year. This is limited to one family per power category.
  Alternatively, the Panel also recommended, at the manufacturer's choice by hp category, a program that eliminates the "single family provision" restriction with revised total and annual sales limits as shown below:
  - for categories ≤175 hp - 525 previous Tier engines (over 7 years) with an annual cap of 150 units (these engine numbers are separate for each hp category defined in the regulations)
  - for categories of > 175hp - 350 previous Tier engines (over 7 years) with an annual cap of 100 units (these engine numbers are separate for each hp category defined in the regulations)

  The Panel recommended that EPA seek comment on the total number of engines and annual cap values listed above. In contrast to the Tier 2/Tier3 rule promulgated in 1998, SBA expects the transition to the Tier 4 technology will be more costly and technically difficult. Therefore, the small equipment manufacturers may need more liberal flexibility allowances especially for equipment using the lower hp engines. The Panel's recommended flexibility may not adequately address the approximately 50 percent of small business equipment models where the annual sales per model is less than 300 and the fixed costs are higher. Thus, the SBA and OMB Panel members recommended that comment be sought on implementing the small volume allowance (700 engine provision) for small equipment manufacturers without a limit on the number of engine families which could be covered in any hp category.

- Due to the changing nature of the technology as the manufacturers transition from Tier 2 to Tier 3 and Tier 4, the Panel recommended that the equipment manufacturers be permitted to borrow from the Tier3/Tier 4 flexibilities for use in the Tier 2/Tier 3 time frame.

- Lastly, the Panel recommended proposing a continuation of the current transition provisions, without modifications to the levels or nature of the provisions, that are available to these manufacturers.

To maximize the likelihood that the application of these provisions will result in the availability of previous Tier engines for use by the small equipment manufacturers, the Panel recommended that - similar to the application of flexibility options that are currently in place - these provisions should be provided to all equipment manufacturers.[306]

During the SBAR Panel process, an issue was raised requesting that EPA establish a provision which would allow small entity manufacturers to request limited "application specific" alternative standards for equipment configurations which present unusually challenging technical issues for compliance. The Panel recommended that EPA seek comment on the need for and value of special application specific standards for small equipment manufacturers.

ii. What EPA is Proposing

EPA is in fact proposing the Percent-of-Production and Small Volume Allowances for all equipment manufacturers, and explicitly took the Panel report into account in making that proposal (see Section VII.B. above). The Agency believes that this proposal should provide the type of transition leeway recommended by the Panel. EPA believes that the transition provisions could allow small equipment manufacturers to postpone any redesign needed on low sales volume or difficult equipment packages, thus saving both money and strain on limited engineering staffs. Within limits, small equipment manufacturers would be able to continue to use their current engine/equipment configuration and avoid out-of-cycle equipment redesign until the allowances are exhausted or the time limit passes.

With respect to these transition provisions, EPA requests comment on the Panel's suggested exemption and annual cap values listed above. As discussed above in Section VII.B, EPA also requests comment on implementing the small volume allowance provision without the single family limit provision using caps slightly lower than 700 units, with this provision being applied separately to each engine power category subject to the proposed standards.

Similar to the discussion in Section VII.B above, EPA requests comment on new proposed requirements associated with use of transition provisions by foreign importers. During the SBREFA Panel process, the Panel discussed the possible misuse of the transition provisions by using them as a loophole to enter the nonroad diesel equipment market or to gain unfair market position relative to other manufacturers. The Panel recognized that this was a possible problem, and believed that the requirement that small equipment manufacturers and importers have reported equipment sales using certified engines in model year 2002 or earlier was sufficient to alleviate this problem. Upon further analysis, EPA found that importers of equipment from a foreign equipment manufacturer could as a group import more excepted equipment from that foreign manufacturer than 80% of that manufacturer's production for the United States market or more than the small volume allowances identified in the transition provisions. This also creates a potentially significant disparity between the treatment of foreign and domestic equipment

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[306] The Panel recognized that, similar to the Tier 2/3 standards, it may be necessary to provide transition provisions for all equipment manufacturers, not just for small entities; and the Panel recommended that this be taken into account. However, the work of the SBAR Panel is meant to develop regulatory alternatives for small manufacturers, thus the Panel nominally recommended transition provisions for small equipment manufacturers only.

manufacturers. EPA did not intend this outcome, and does not believe it is needed to provide reasonable leadtime to foreign equipment manufacturers.

Therefore, as explained earlier in Section VII.B, EPA is requesting comment on the additional requirement that only the nonroad diesel equipment manufacturer that is most responsible for the manufacturing and assembling process, and therefore the burden of complying with the proposed standards, would qualify for the allowances provided under the small equipment manufacturer transition provisions. Under this requirement, only an importer that produces or manufactures nonroad diesel equipment would be eligible for these transition provisions. An importer that does not manufacture or produce equipment does not face a burden in complying with the proposed standard, and therefore would not receive any allowances under these transition provisions directly, but could import exempt equipment if it is covered by an allowance or transition provisions associated with a foreign small equipment manufacturer. EPA believes that this requirement transfers the flexibility offered in these transition provisions to the party with the burden and would allow transition provisions and allowances to be used by foreign equipment manufacturers in the same way as domestic equipment manufacturers, while avoiding the potential for misuse by importers of unnecessary allowances. EPA also sees no reason that this provision should not apply in the same way to all importers, and thus (as explained in Section VII.B) is proposing that the provision apply uniformly.

EPA is also proposing the Panel's recommendation that equipment manufacturers be allowed to borrow from Tier 4 flexibilities in the Tier2/3 timeframe. See the more extended discussion on this issue in Section VII.B above.

With regard to the Panel recommendation for a provision allowing small manufacturers to request limited "application specific" alternative standards for equipment configurations which present unusually challenging technical issues for compliance, EPA requests comment on this recommendation. EPA believes that the need for such a provision has not been established and that it likely would provide more lead time than can be justified, and could undermine emission reductions which are achievable. Moreover, no participant in the SBAR process offered any empirical support that such a problem even exists. Nor have such issues been demonstrated (or raised) by equipment manufacturers, small or large, in implementing the current nonroad standards. In addition, EPA believes that any application-specific difficulties can be accommodated by the transition provisions the Agency is proposing including ABT. Nonetheless, in keeping with the SBAR recommendations, comment is requested on the value of, and need for, special application specific standards for small equipment manufacturers.

b. Hardship Provisions for Small Equipment Manufacturers

i. What the Panel Recommended

The Panel also recommended that two types of hardship provisions be extended to small equipment manufacturers. These provisions are:

- For the case of a catastrophic event, or other extreme unforseen circumstances, beyond the control of the manufacturer that could not have been avoided with reasonable discretion (i.e. fire, tornado, supplier not fulfilling contract, etc.).

- For the case where a manufacturer has taken all reasonable business, technical, and economic steps to comply but cannot. In this case relief would have to be sought before there is imminent jeopardy that a manufacturer's equipment could not be sold and a manufacturer would have to demonstrate to the Agency's satisfaction that failure to get permission to sell equipment with a previous Tier engine would create a serious economic hardship. Hardship relief of this nature cannot be sought by a 'integrated' manufacturer (one which also manufactures the engines for its equipment).

ii. What EPA is Proposing

EPA is proposing that the Panel recommended hardship provisions be extended to small equipment manufacturers in addition to the transition provisions described above. To be eligible for these hardship provisions (as well as the proposed transition provisions), equipment manufacturers and importers must have reported equipment sales using certified engines in model year 2002 or earlier. As explained earlier, this proposal is needed to thwart misuse of these provisions as a loophole to enter the nonroad diesel equipment market or to gain unfair market position relative to other manufacturers. We request comment on this restriction.

As explained earlier, hardship relief would not be available until other allowances have been exhausted. Either relief provision would provide small equipment manufacturers with additional lead time for up to two model years based on the circumstances, but EPA may require recovery of the lost environmental benefit.

EPA requests comment on all of the aspects of the proposed hardship provisions for small equipment manufacturers.

D. Phase-In Provisions

In Section III we described the proposed NOx and NMHC standards phase-in schedule. This phase-in requirement is based on percentages of a manufacturer's production for the U.S. market. We recognize, however, that manufacturers need to plan for compliance well in advance of the start of production, and that actual production volumes for any one model year may differ from their projections. On the other hand, we believe that it would be inappropriate and infeasible to base compliance solely on a manufacturer's projections. That could encourage manufacturers to overestimate their production of complying phase-in engines, and could result in significantly lower emission benefits during the phase-in. We voiced the same concern with respect to the highway HDDE phase-in schedule (see 66 FR 5109). As in the highway HDDE program we propose to initially only require nonroad diesel manufacturers to project compliance with the phase-in based on their projected production volumes, provided that they made up any deficits (in terms of percent of production) the following year.

Because we expect that a manufacturer making a good-faith projection of sales would not be very far off of the actual production volumes, we are proposing to limit the size of the deficit that would be allowed, as in the highway program. In all cases, the manufacturer would be required to produce at least 25% of its production in each phase-in power category as "phase-in" engines (meeting the proposed NOx and NMHC standards or demonstrating compliance through use of ABT credits) in the phase-in years (after factoring in any adjustments for Early Introduction or Blue Sky Series engine credits; see Section VII.E). This minimum required production level would be 20% for the 75-175 hp category if a manufacturer exercises the option to comply with a reduced phase-in schedule in lieu of using banked Tier 2 ABT credits, as discussed in Section III.B1.b. Another important proposed restriction is that manufacturers would not be allowed to have a deficit in the year immediately preceding the completion of the phase-in to 100%. This would help ensure that manufacturers are able to make up the deficit. Since they could not produce more than 100% low-NOx engines after the final phase-in year, it would not be possible to make up a deficit from this year. These provisions are identical to those adopted in the highway HDDE program.

E. What Might Be Done to Encourage Innovative Technologies?

1. Incentive Program for Early or Very Low Emission Engines

In our rulemakings for heavy-duty highway engines and light-duty Tier 2 vehicles, we expressed our view that providing incentives for manufacturers to introduce engines emitting at very low levels early, or at levels significantly below the final standards, is appropriate and beneficial. We believe that such inducements may help pave the way for greater and/or more cost effective emission reductions from future engines and vehicles. We believe this also holds for the early introduction of low-emitting nonroad diesel engines. We also believe that the opportunity for a practical early-engine program is even greater for the nonroad sector than for the highway sector, considering the long lead times before these proposed nonroad diesel standards would take effect, the large variety of applications (and therefore potential pull-ahead opportunities) in the nonroad sector, the large number of machines fueled at dedicated fuel stations on construction sites, farms, and industrial complexes, and the widespread availability of very low sulfur diesel fuel at highway outlets after 2006, even sooner in some areas. Thus we are proposing an early-engine incentive program very similar to that adopted for highway engines and vehicles.

Specifically, we are proposing that manufacturers be permitted to take credit for engines certified to this rule's proposed standards prior to the 2011 model year in exchange for making fewer engines certified to these standards in or after the 2011 model year. In other words, clean engines sold earlier than required reduces the requirement to sell similar engines later. The emission standards levels must actually be met by qualifying engines to earn the early introduction credit, without use of ABT credits. Therefore, the early introduction engine credit is an alternative to the ABT program in that any early engines or vehicles can earn either the engine credit or the ABT emission credit, but not both. The purpose of the incentive is to encourage introduction of clean technology engines earlier than required in exchange for added flexibility during the phase-in years.

Any early engine credits earned for a diesel-fueled engine would be predicated on the assurance by the manufacturer that the engine would indeed be fueled with low sulfur diesel fuel in the marketplace. We expect this would occur through selling such engines into fleet applications, such as municipal maintenance fleets, large construction company fleets, or any such well-managed centrally-fueled fleet. Because obtaining a reliable supply of 15 ppm maximum sulfur diesel fuel prior to the 2011 model year will require some effort by nonroad diesel machine operators, we believe it is necessary and appropriate to provide a greater incentive for early introduction of clean diesel technology. Therefore, we propose to count one early diesel engine as 1.5 diesel engines later. This extra early credit for diesel engines means that fewer clean diesel engines than otherwise would be required may enter the market during the years 2011 and later. But, more importantly, it means that emission reductions would be realized earlier than under our base program. We believe that providing incentives for early emission reductions is a worthwhile goal for this program, because improving air quality is an urgent need in many parts of the country as explained in Section II, and because the early learning opportunity with new technologies can help to ensure a smooth transition to Tier 4 standards. Therefore, we are proposing these provisions for manufacturers willing to make the early investment in cleaner engines.

We are proposing to provide this early introduction credit to diesel engines at or above 25 hp that meet all of today's Tier 4 emissions standards (NOx, PM, and NMHC) in the applicable power category. We are also providing this early introduction credit to diesel engines that pull-ahead compliance with only the PM standard. However, a PM-only early engine would offset only the "phase-out" engines during the phase-in years (those required to meet the Tier 4 standard for PM but not for NOx or NMHC); it would not offset engines required to meet the Tier 4 NOx, NMHC, and PM standards. Tier 4 engines certified to, or required to meet, the 2008 PM standard would not participate in this program, either as credit generators or as credit users.

An important aspect of the early incentive provision is that it must be done on an engine count basis. That is, a diesel engine meeting new standards early would count as 1.5 such diesel engines later. This contrasts with a provision done on an engine percentage basis which would count one percent of diesel engines early as 1.5 percent of diesel engines later. Basing the incentive on an engine count would alleviate any possible influence of fluctuations in engine sales in different model years.

Another important aspect of this proposed program is that it would be limited to engines sold prior to the 2011 model year for engines at or above 175 hp, prior to the 2012 model year for engines between 75 and 175 hp, or prior to the 2013 model year for engines between 25 and 75 hp. In other words, as in the highway program, nonroad diesel engines sold during the transitional "phase-in" model years would not be considered "early" introduction engines and would therefore receive no early introduction credit. However, such engines and vehicles would still be able to generate ABT credits. As with the phase-in itself, and for the same reasons, we are proposing that an early introduction credit could only be used to offset requirements for engines in the same power category as the credit-generating engine (see Section III.B).

As a further incentive to introduce clean engines and vehicles early, we are also proposing a provision that would give manufacturers an early introduction credit equal to two engines during or after the phase-in years. This “Blue Sky” incentive would apply for diesel engines achieving standards levels at one-half of the proposed long-term NOx standard while also meeting the NMHC and PM standards. Due to the extremely low emission levels to which these Blue Sky series engines and vehicles would need to certify, we believe that the double engine count credit is appropriate. Table VII.E-1 shows the emission levels that would be required for diesel engines to earn any early introduction credits (other than ABT credits).

TABLE VII.E-1 – PROPOSED PROGRAM FOR EARLY INTRODUCTION OF CLEAN ENGINES AT OR ABOVE 25 HP

Category	Must Meet [a]	Per Engine Credit
Early PM-only [b]	0.01 g/bhp-hr PM ($\geq$ 75 hp) or 0.02 g/bhp-hr PM (< 75 hp)	1.5-to-1 PM-only
Early Engine [b]	above-indicated PM standard + 0.30 / 0.14 g/bhp-hr NOx / NMHC ($\geq$ 75 hp) or 3.5 g/bhp-hr NMHC + NOx (< 75 hp)	1.5-to-1
Blue Sky Series Engine	as above for Early Engine, except must meet 0.15 g/bhp-hr NOx standard	2-to-1

Notes:
[a] Engines in all 3 categories must also meet the Tier 4 crankcase emissions requirements.
[b] Engine count credits must be earned prior to the start of phase-in requirements in applicable power categories (prior to 2103 for 25-75 hp engines).

We welcome comment on these proposed provisions, as well as other ideas for encouraging the introduction of Tier 4 engines early, or of engines cleaner than Tier 4 levels. One area we especially seek comment on is whether or not engines below 25 hp that achieve the proposed long-term Tier 4 PM standard for 25-75 hp engines of 0.02 g/bhp-hr, or engines below 75 hp that achieve the proposed long-term Tier 4 NOx standard for >75 hp engines of 0.30 g/bhp-hr, should gain credits under this program that could be used to offset requirements for larger engines, as a means of encouraging the migration of clean technologies to smaller engines.

2. Continuance of the Existing Blue Sky Program

In the 1998 final rule, the Agency established its original Blue Sky Series Engine program for nonroad diesel engines (63 FR 56968; see preamble Section III.I). This program encourages the early introduction of engines with emission levels (as measured on a transient test) about 40% lower than the Tier 2 standards levels. Manufacturers could designate these engines as Blue Sky Series engines and sell them for use in state, municipal, or commercial programs calling for these cleaner engines (but not in the ABT program, to avoid double-counting of emission reductions). Because the Agency's direction for the nonroad engine program was not completely settled at the time, the 1998 final rule limited the Blue Sky program to engines built in the 2004 and earlier model years, but discussed our intent to consider extending it later. This Tier 4 proposal does provide more clarity for the future direction of the nonroad engine program, and so at this time we are asking for comment on extending or revising the existing Blue Sky Series engine program. We believe that the levels set for the existing Blue Sky program are not stringent enough to warrant their continuance into the Tier 4 years, but we also note that the lack of a transient certification test in Tier 3 may make continuance of this program beyond 2004, perhaps through Tier 3 (and Tier 2 for engines under 50 hp), useful. We welcome comment on this, as well as on any experience with the program thus far, plans to use it in the future, whether the standards and test cycle should be changed and, if so, beginning in what model year.

F. Provisions for Other Test and Measurement Changes

This section contains further detail and explanation regarding several related nonroad diesel engine emissions test and measurement provisions. There are five topics which will be discussed: 1) EPA's proposed supplemental nonroad transient test; 2) an additional cold start transient test requirement for nonroad diesel engines; 3) a provision for control of smoke testing; 4) steady-state testing; 5) maximum test speed; and 6) general improvements to test procedure precision.

1. Supplemental Transient Test

Nonroad diesel engines and equipment for the most part run on a more transient basis than their highway diesel counterparts through operations such as shifting loads, powering auxiliary equipment and performing repetitive tasks. A smaller, but significant, transient segment of nonroad equipment operates in a constant-speed manner for most or all of its useful life as with electrical generating sets, arc welders and the like. However, nonroad test regulations to date have tended to not capture a broad area of real world operating characteristics and the emissions which result from these modes of equipment operation. The Agency believes that it is important to ensure that nonroad engines meet emission standards in-use under typical operating conditions so that the expected benefits of the program will be achieved over the life of the program. The supplemental nonroad diesel engine transient test provisions EPA is proposing are intended to help achieve this goal. Steady-state emission testing of nonroad diesel engines will be retained because it covers types of in-use diesel engine operation not represented in nonroad diesel transient operation. Steady-state emission testing provides a benchmark as well for simpler test programs, like Selective Enforcement Audits (SEAs).

As explained in section III.C. above, EPA is proposing to supplement its steady-state emission testing in nonroad diesel engines with a transient duty emission test procedure for nonroad diesel engines, the Nonroad Transient Composite (NRTC)[307] test cycle. The Agency's NRTC cycle is described in proposed regulations at 40 CFR part 1039. A detailed discussion of the proposed transient test cycle and its derivation is contained in Chapter 4 of the Draft RIA for this proposal. Like current nonroad diesel standards, any new emission standards would apply to certification, Selective Enforcement Audits (SEAs), and equipment in actual use for engines covered by the standards.

EPA's supplemental nonroad transient test will apply to a nonroad diesel engine when that engine must first show compliance with EPA's proposed Tier 4 PM and NOx+NMHC emissions standards which are based on the performance of the advanced post-combustion emissions control systems (e.g. CDPFs and NOx adsorbers), with the specific exception of engines under 25 hp for PM and under 75 hp for NOx. The transient duty cycle would be applicable to Tier 4 phase-in engines, as well as the phase-out engines (as defined in section III.B.1.b of this preamble). However, we are seeking comment on whether the transient test procedure should only be required for the PM standard for phase out engines. The table VII.F.-1 below outlines the dates for implementation of this requirement and notes specific exceptions for phase-in of some engine standards.

Table VII.F.-1. Implementation Model Year for Nonroad Transient Testing

Power Category	Transient Test Implementation Model Year[a]
< 25 hp	2013
$25 \leq$ hp < 75	2013[b]
$75 \leq$ hp < 175	2012
$175 \leq$ hp ≤ 750 hp	2011
>750 hp	2011[c]

NOTE: a). We are taking comment on whether the transient test procedure should only be required for the PM standard for phase out engines under 750 hp and we are seeking comment on not requiring the transient test procedure for carry over engines over 750 hp.
b). The transient test would apply in 2012 for any engines in the 50-75 hp range that choose not to comply with the proposed 2008 transitional PM standard.
c). Beginning in 2014, when the phase-in has been completed, the transient test would apply to all nonroad engines >750 hp, however we are taking comment on this approach.

[307] Memoranda to Docket A-2001-28: "Speed and Load Operating Schedule for the Nonroad Transient Composite test cycle" and "NRTC Cycle Construction"

While manufacturers of nonroad diesel engines under 75 hp are not subject to the transient test procedure and therefore not required to submit data demonstrating that their engines will meet the Tier 4 nonroad PM emission standard beginning in 2008, it is our expectation that manufacturers, in anticipation of the transient test requirements and in accordance with applicable defeat device prohibitions, would design their engines with effective, in-use control over the expected range of operating conditions, including transients. Given this, we feel this affords a good balance to address workload constraints for these manufacturers as they prepare for addressing Tier 4 compliance. As explained earlier in section III of this preamble, actual submission of transient test data will not be required of engine manufacturers in these power categories until 2013[308]. EPA recognizes that the timing of interim standards for these engines could otherwise force manufacturers of smaller engines to have to certify under the proposed NRTC duty cycle test requirement before the requirement applies to the broader market of engine manufacturers in the 2011 to 2013 time frame.

The Agency notes however that some manufacturers have reported difficulties measuring transient PM emissions in 750 hp and over engines under full-flow constant volume sampling (CVS) emission measurement systems. It has been reported that this may be due to difficulties apportioning the large exhaust volumes to sample emissions. Additionally, manufacturers have raised concerns regarding a requirement to conduct transient testing for engines over 750 hp, based on concerns related to facility impacts and sales volumes that are particular for engines over 750 hp. To address the concerns raised, the Agency is taking comment on not requiring the engine manufacturer to conduct transient testing for engines over 750 hp for purposes of certification. Manufacturers would have the option to submit an engineering analysis that demonstrates compliance with the applicable transient standard. This engineering analysis would have to include relevant test data, such as steady state test data, that would support the engineering analysis.

Similarly, PM exhaust emissions gathered from these large engines using partial flow sampling systems (PFSS) tend to be high in volatile PM fractions[309] under some low load operating modes. To date, volatile PM measured from PFSS has not been proven to be consistently comparable to volatile PM measured by a full-flow CVS. The pressure across the filter and other sample zone conditions, coupled with differences in the dilution rate and method and residence time, may combine to yield a different PM composition in PFSS than in full-flow CVS systems at these operating conditions. EPA requests comment from manufacturers on the use of PFSS test practices for PM emission data collection in these large displacement engines.

EPA recognizes that there may be practical difficulties with emission testing in large nonroad diesel engines over 750 hp, systems which often have multiple exhaust manifolds and may incorporate several catalysts or other pieces of emission control equipment. Further, the Agency does not intend at this time to require that manufacturers use PFSS to determine PM

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[308] See Note “b” in Table VII-F-1 above for engines between 25 and 75 hp (19-56 kW).

[309] Memorandum to Docket “Partial Flow Testing Concerns in Large Nonroad Diesel Engines as Regards Emission Testing Through Partial Flow Sampling”, Docket A-2001-28.

emissions from their engines for certification. A large engine manufacturer may, however, choose to submit PM data to the Agency using PFSS as an alternative test method, if that manufacturer can demonstrate test equivalency using a paired-T test, as outlined in regulations at 40 CFR 86.1306-07.

EPA is also proposing, as an alternative to the NRTC for a limited class of engines, a Constant Speed Variable Load (CSVL) transient duty cycle. The CSVL transient duty cycle is derived from the EPA's Arc Welder Highly Transient Torque application duty cycle. The CSVL cycle is described in the proposed regulations at 40 CFR 1039.510. Because of the more limited range of engine operation in the CSVL cycle, manufacturers must ensure that engines certified with data generated with this cycle are used exclusively in constant-speed applications. Accordingly, these engines must include labeling information indicating this limited emission certification. An example of engines in this category of nonroad diesel equipment include power generating sets which are very tightly governed for operating speed changes. Other "constant speed" equipment may be less closely regulated for changes in speed such as those that utilize a 3% droop-type of engine speed governor. One might expect that this latter group would more easily pass cycle performance statistics over a constant speed transient test than the more speed change-sensitive former group, represented by electrical generating sets, for example. However, both types of constant speed engines experience some fluctuations in speed and load during operation in-use and the CSVL duty cycle would capture emissions from these infrequent modes of operation, as well.

Transient testing requires consideration of statistical parameters for verifying that test engines adequately follow the prescribed schedule of speed and load values. The proposed regulations in §1065.530 detail these statistical parameters (or "cycle statistics") for nonroad diesel engines. These values are somewhat different than the comparable values for highway diesel engines to take into account the characteristics of the nonroad composite cycle and the CSVL cycle. Note also that we are proposing to modify certain cycle statistics previously established for nonroad spark-ignition engines. These changes generally allow testing spark-ignition engines in a way that follows the speed and load traces somewhat less precisely than previously established. All of the proposed changes for spark-ignition engines are consistent with the comparable cycle statistics we are proposing for nonroad diesel engines.

While designed to control for a broad range of constant-speed nonroad engines, the Agency's CSVL cycle has an average speed which may be lower than the speed which a manufacturer considers optimal for their engines in-use. Further, EPA recognizes that some constant speed equipment may operate near or at its rated engine rpm during much of that equipment's useful life. As such, EPA is proposing that constant-speed engines tested in the laboratory with installed speed governors be required to meet cycle statistics for engine load, but not for engine speed. This addresses the concern that different engines may have different degrees of engine speed variation and that some engines may be set to operate at speeds slightly different than the defined point of maximum test speed. At the same time, the installed governor forces the test engine to operate in a way that is representative of in-use operation. This is described further in Chapter 4 of the Draft RIA for this rulemaking.

Engine manufacturers have raised additional concerns about designing constant-speed engines to meet emission standards over the CSVL cycle. These concerns generally focus on the fact that the cycle has relatively light engine loads and is derived from an arc welder powered by a naturally aspirated engine. Manufacturers questioned the representativeness of this cycle for generators, which is a more common application for constant-speed engines. We continue to believe that transient testing of these engines will add assurance that they control emissions under real in-use operation. While the CSVL cycle does not capture the full operating experience of every engine application, we believe that engines designed to this cycle will control emissions effectively under other types of transient operation not specifically included in the certification procedure. Especially given the anticipated emission-control technologies, we believe engines that are capable of meeting emission standards on the CSVL cycle will have the transient-response characteristics that are appropriate for controlling emissions at higher engine loads and for less dynamic transient operation. At the same time, we share engine manufacturers' interest in creating duty cycles that achieve in-use emission reductions without requiring approaches that lead to laboratory improvements unrelated to an engine's in-use operation. We are therefore expecting to continue discussions with engine manufacturers to pursue the possibility of developing a constant-speed transient cycle that addresses these concerns. We request comment on the extent to which the CSVL cycle will pose design burdens or constraints unrelated to improving in-use emission control.

EPA recently adopted a similar transient duty cycle for spark-ignition constant-speed engines (67 FR 68242, 68298-99, November 8, 2002). This duty cycle, which is based on the same underlying engine operation of an arc welder powered by a diesel engine, includes a combination of equal parts typical and high-transient operation. There was no effort to modify the schedule of engine operation to make it more representative of spark-ignition engines, so the expectation was that the same cycle would eventually apply to nonroad diesel engines. Aside from the different selection of engine operation from the available operating welder described above, the proposed constant-speed transient cycle includes several adjustments that would need to be factored into the "spark-ignition" cycle before it could be applied to nonroad diesel engines. These adjustments include renormalization with a more robust engine map (based on updated specifications of the original engine) and "I-alpha" corrections to synchronize measurements made with and without a flywheel (see Section 4.2.8.1 of the Draft RIA). EPA requests comment on whether the previously adopted constant-speed transient cycle (in modified form) should apply equally to nonroad diesel engines. Conversely, if EPA adopts the proposed constant-speed transient cycle for nonroad diesel engines, we would expect to change the regulations for spark-ignition engines to align with the conclusions in this rulemaking. EPA accordingly requests comment on these same issues as they relate to spark-ignition engines.

EPA is proposing an optional test cycle specifically for engines used in transport refrigeration units (TRUs). These engines would be certified to a four-mode steady-state duty cycle, developed by the California-EPA Air Resources Board.[310] Two modes would be run at the engine's maximum test speed, one mode at 50% of observed engine torque and the other mode at

[310] Information on the proposed TRU cycle may be found on the California ARB website at http://www.arb.ca.gov/diesel/dieselrrp.htm.

75% of observed engine torque. The third and fourth modes would be run at the engine's intermediate test speed and, again, one mode would be run at 50% of observed engine torque and the other mode at 75% of observed engine torque. All four modes would be weighted equally in determining an operating mode's contribution to the engine's emissions.

Manufacturers certifying engines to the TRU cycle would need to state on the emission control label that the engines may only be used in TRUs, provide installation instructions to ensure they will operate only in the modes covered by the test cycle, and keep records on delivery destinations for these engines. Although these engines would not be subject to a transient duty cycle, they would be subject to not-to-exceed standards based on any normal operation that they might experience in the field. Manufacturers of these engines may petition EPA at certification for a waiver of the requirement to provide smoke emission data for their constant-torque engines. We request comment on whether different modes, or different weighting factors, would be more appropriate for characterizing TRU emissions.

2. Cold Start Testing

EPA is proposing to include a requirement for a cold start transient test to be run in conjunction with the Agency's proposed nonroad diesel engine transient test. While EPA does not have available a database of emission information to characterize cold start emissions from all power categories of nonroad diesel engines, EPA has been able to analyze the second-by-second in-use operation of some forty pieces of Tier 1 and older nonroad equipment. Using a subset of equipment from this study, the Agency characterized the "average" workday of each piece of equipment in the data set[311] and attempted to define the role "cold start"operation, generally characterized by lower exhaust temperatures and higher-than-idle engine speeds, played in engine emissions. Generally, the Agency found that times when the engine was operating at cold start, higher engine emission rates were seen than during normal, temperature-stabilized operation of the engine. These cold start, or "warming-up", periods were seen to last on average ten minutes after equipment key-on for the units in our study.

The Agency found, that over an eight to ten hour workday, a piece of nonroad equipment would spend between 25 and 35 percent of its in-use day running in idle operation at a relatively low rate of emission output. With downtime on the equipment for operator lunch times and equipment transport, there could be a further period of an hour or more of low to no emissions from the equipment in-use. At first key-on of the workday, and with each additional "key-on" cold start event during the day, the equipment experiences a period of higher emissions until it reaches a stabilized operating temperature. Start-up of the equipment after a period of downtime which lasted an hour or more was generally seen to experience rates of engine emissions similar to those seen at first key-on, or cold start, and were considered periods of cold start emissions, as well. The total time the equipment in the study spent at these higher rates of "cold start" engine

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[311] Memorandum to Docket, "Analysis of Second-by-Second Emission and Activity Data for a Private Rental Fleet of Construction Equipment" Docket A-2001-28.

emissions could be estimated to generate approximately one-tenth of the engine emissions that the equipment would be expected to produce over the whole workday. Therefore, EPA proposes to weight the emission test results from its additional cold start transient test requirement as one tenth of the composite transient emission test results for a particular engine. The Agency requests comments as to the robustness of this weighting factor and as to its applicability across the spectrum of nonroad diesel equipment.

In addition, EPA requests comment on the potential to apply an approach adopted for commercial spark-ignition engines, in which engines operate over a single "warm-start" cycle (67 FR 68298, November 8, 2002; see 40 CFR 1048.510), to nonroad diesel engines. The regulations for these spark-ignition engines address cold-start emissions indirectly through a combination of provisions. First, the warm-up period before emission measurement can start is limited to three minutes of operation. As a result, any engine operation after this three-minute period is fully accounted for by emission measurements. Second, the regulations direct manufacturers to design their emission-control systems to start working as soon as possible after engine starting and to describe in their application for certification how their engines meet this objective. For engines that take advantage of the period of unmeasured emissions with a design that has unnecessarily high emissions, we can consider this a defeat device and deny certification. Manufacturers therefore need to take steps to design their engines and any emission-control equipment to control emissions during the warm-up period without the additional effort of supplemental cold-start testing. EPA requests comment on whether this approach would be appropriate for nonroad diesel engines. In particular, we request comment on how long the warm-up period prior to start of emissions measurement should be for diesel engines. The three-minute warm-up period specified for these spark-ignition engines reflects the time needed for their catalysts to start working. The emission-control technologies anticipated for diesel engines under this proposal would need additional time, perhaps 10 minutes, before they achieved nearly full effectiveness in controlling diesel emissions. Any comments regarding this approach should address how the changed procedure would affect measured emission levels and how the emission standard should be adjusted to reflect these changes.

3. Control of Smoke

Manufacturers are currently responsible for testing and reporting results for nonroad "peak acceleration" and "lugging" smoke emissions. These regulations are detailed in 40 CFR 89.113[312] and refer the reader back to 40 CFR 86, subpart I, which was developed for highway engines. This rulemaking however proposes to replace the present Federal Smoke Procedure for nonroad engines with the ISO 8178 Part 9 nonroad smoke procedure as the method and standards by which engine manufacturers will certify their nonroad engines. This new smoke testing procedure with its related smoke standards will become effective for a particular engine when that engine is

[312] Smoke testing guidelines are detailed under ISO 8178-9, First Ed. 10-15-2000, "Reciprocating internal combustion engines-Exhaust emission measurement- Part 9: Test cycles and test procedures for test bed measurement of exhaust gas smoke emissions from compression ignition engines operating under transient conditions". A copy of the testing procedure may be found for reference only in Docket A-2001-28.

certified to EPA's proposed Tier 4 or transition PM and NOx-NMHC standards. Proposed regulations may be found at 40 CFR part 1039.

The ISO-TC70/SC8/WG1 committee developed a nonroad smoke test procedure, ISO 8178-9 and finalized it on October 15, 2000. Recognizing the value of harmonized test procedures and limit standards, EPA is proposing through this rulemaking to use ISO 8178-9 for smoke testing of nonroad diesel engines. EPA has analyzed ISO 8178-9 and concluded that it is appropriate for adoption within the Agency's nonroad test procedures. It is important to note that the ISO 8178-9 smoke emissions test procedure is very different from the procedure specified in Subpart I of Part 86. As a consequence, in adopting the ISO 8178-9 procedure, EPA proposes to revise the numerical limit value associated with this ISO procedure. EPA proposes that the appropriate (maximum) numerical standard for ISO 8178-9 peak (acceleration) smoke value measurement will be 20 percent opacity, peak smoke values at 3x, 6x, and 9x will be 18 percent opacity, 16 percent opacity and 14 percent opacity, respectively, and the lug smoke value will be 10 percent opacity. The Agency has determined this value on review of data from smoke tests on various engines[313] across differing programs and requests comment as to the appropriateness of these particular limit values.

Some state governments have expressed a desire for a federal smoke regulatory program that would enable them to test in-use nonroad engines in a manner that would permit action against gross emitters of smoke. In a like manner, EPA could propose additional smoke testing regulations as part of any future rulemaking which would address manufacturer's in-use smoke test requirements. The main elements of any in-use smoke program would be a new Federal smoke standard(s) and test procedure for new engines, guidance from EPA for state in-use smoke control programs (including a full smoke test procedure and accompanying state limit values), and a means by which the data from the two programs could be related. The current smoke test procedure from Part 86, Subpart I does not provide data comparable to the most practical in-use smoke test procedure, a snap-idle acceleration test with measured opacity. However, based on the current ISO 8178-9 procedure, EPA believes data from an ISO 8178-9 certification smoke test could provide the desired link.

In applying nonroad smoke standards and procedures to engines rated 50 hp and under, EPA has chosen to exempt one-cylinder engines, the large majority of which are being used in generator sets and other constant-speed applications, from the smoke standards. EPA still believes that testing of these engines is unique in ways that would need to be addressed before requiring smoke standards and testing for this class of engines. These engines tend to produce puffs of smoke that may make the smoke measurement erratic. The Agency believes the air quality impact of this decision will be minimal. EPA expects to reconsider this issue in the future in relation to other in-use testing concerns.

Finally, the Agency proposes to exempt from smoke standards those nonroad diesel engines which have certified PM emission levels or Family Emission Limits (FELs) below 0.05

[313] "Nonroad Diesel Engine Smoke Testing and Limited Filter Analysis" May, 2001.Final Report to Engine Manufacturers Association from Southwest Research Institute. Docket A-2001-28

g/hp-hr. The Agency believes that engines meeting an FEL below 0.05 g/hp-hr would utilized control technology, such as particulate traps, that would provide adequate smoke control.

4. Steady-State Testing

Recognizing the variety of both power classes and work applications to be found within the nonroad vehicle and engine population, EPA will retain current Federal steady-state test procedures for nonroad engines. The steady state duty cycle applicable in each of the following categories: 1) nonroad engines 25 hp and greater; 2) nonroad engines less than 25 hp; and 3) nonroad engines having constant-speed, variable-load applications, (e.g., generator sets) as set out in Table VII.F-2. The steady-state cycles remain, respectively, the 8-mode cycle, the 6-mode cycle and the 5-mode cycle.[314] We envision manufacturers that satisfy the requirements to certify on the steady state ISO 8178-D2 duty cycle might likewise satisfy the requirements to test over the Constant Speed Variable Load Duty Cycle (CSVL). Manufacturers will be required to meet emission standards under steady-state conditions, in addition to meeting emission standards under the proposed supplemental transient test cycle. Steady-state test cycles are needed so that testing for certification will reflect the broad range of operating conditions experienced by these engines. A steady-state test cycle represents an important type of modern engine operation, in power and speed ranges that are typical in-use. The mid-to-high speeds and loads represented by present steady-state testing requirements are the speeds and loads at which these engines are designed to operate for extended periods for maximum efficiency and durability. Details concerning the three steady-state procedures for nonroad engines and equipment can be found in proposed regulations at proposed 40 CFR 1039.510 and in the three appendices which follow that section, one for each cycle.

Manufacturers would perform each steady-state test following all applicable test procedures in proposed regulations at proposed 40 CFR part 1039, e.g., procedures for engine warm-up and exhaust emissions measurement. We are proposing that the testing must be conducted with all emission-related engine control variables in the maximum NOx-producing condition which could be encountered for a 30 second or longer averaging period at a given test point. Table VII.F.-2 below summarizes the steady-state testing requirements by individual engine power categories.

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[314] The three proposed steady-state test cycles are similar to test cycles found in the International Standard ISO 8178-4:1996 (E) and remain consistent with the existing 40 CFR part 89 steady state duty cycles.

Table VII.F-2 – Summary of Steady-State Test Requirements

Nonroad Engine Power Classes	Steady-State Testing Requirements		
	8-Mode Cycle (ISO 8178-4 C1)	6-Mode Cycle (ISO 8178-4 G3)	5-Mode Cycle (ISO 8178-4 D2)
hp < 25 (kW < 19)	NA [a]	applies	applies [b]
25 ≤ hp < 75 (19 ≤ kW < 56)	applies	NA[a]	applies [b]
75 ≤ hp < 175 (56 ≤ kW < 130)	applies	NA[a]	applies [b]
175 ≤ hp ≤ 750 (130 ≤ kW ≤ 560)	applies	NA[a]	applies [b]
hp > 750 (kW > 560)	applies	NA[a]	applies [b]

[a] Testing procedure not applicable to this class of engines.
[b] For constant, or nearly constant, speed engines and equipment with variable, or intermittent, load.

5. Maximum Test Speed

We are proposing to make a slight change to how test cycles are specified. We are proposing to apply the existing definition of maximum test speed in part 1065 to nonroad CI engines. This definition of maximum test speed is the single point on an engine's normalized maximum power versus speed curve that lies farthest away from the zero-power, zero-speed point. This is intended to ensure that the maximum speed of the test is representative of actual engine operating characteristics and is not improperly used to influence the parameters under which their engines are certified. In establishing this definition of maximum test speed, it was our intent to specify the highest speed at which the engine is likely to be operated in use. Under normal circumstances this maximum test speed should be close to the speed at which peak power is achieved. However, in past discussions, some manufacturers have indicated that it is possible for the maximum test speed to be unrepresentative of in-use operation. Since we were aware of this potential during the original development of this definition, we included provisions to address issues such as these. Part 1065 allows EPA to modify test procedures in situations where the specified test procedures would otherwise be unrepresentative of in-use operation. Thus, in cases in which the definition of maximum test speed resulted in an engine speed that was not expected to occur with in-use engines, we would work with the manufacturers to determine the maximum speed that would be expected to occur in-use.

6. Improvements to the Test Procedures

We are proposing changes to the test procedures to improve the precision of emission measurements. These changes address the potential effect of measurement precision on the feasibility of the standards. It is important to note that these changes are not intended to bias results high or low, but only to improve the precision of the measurements. Based on our experience with these modified test procedures, and our discussions with manufacturers about their experiences, we are confident that these changes will not affect the stringency of the standards. These changes are summarized briefly here, and the rationale for the changes affecting Constant Volume Sampling (CVS) and PM testing are summarized in a memo to the docket (Air Docket A-99-06, IV-B-11), which was originally submitted in support of the recent highway heavy-duty diesel engine rule (66 FR 5001, January 18, 2001). The rationale for any other changes are summarized in a memo to the docket for this proposal.

Many of the changes are to the PM sampling procedures. The PM procedures will be the same as those finalized as part of the highway heavy-duty diesel engine rule (66 FR 5001, January 18, 2001). These include changes to the type of PM filters that are used and improvements in how PM filters are weighed before and after emission measurements, including requirements for more precise microbalances.

Another area includes changes to the CVS dilution air and flow measurement specifications to allow for lower dilution ratios. These changes are also the same as those changes finalized in the highway rule.

Another area of change is the NOx calibration procedure. These changes are also the same as those changes finalized in the highway rule. The new calibration procedures will result in more precise continuous measurement of very low concentrations of NOx.

Other changes are being proposed to allow for other measurement options, including the complete or partial adoption of the International Standards Organization’s test procedures as specified in ISO 8178-1 (2002-2003 revision) and ISO 8178-11 DIS. EPA has participated in draft changes to these procedures and feels that adopting these procedures, at least in part, would not only allow for the use of the most technically correct procedures, but would also improve harmonization with international standards, which might offer cost savings for some manufacturers. EPA requests comments on the appropriateness of adopting parts of or all of ISO 8178-1 (2002-2003 revision) and ISO 8178-11 DIS.

If finalized, manufacturers would be allowed to use the new procedures immediately for all certifications of all engines (i.e. to certify any nonroad engine, not just Tier 4 engines), and manufacturers will also be able to use their current procedures up to a certain transition date to allow for a gradual transition to the new procedures. The reason for this is that some of these changes may not be convenient or cost-effective in the short term, and manufacturers may be willing to live with some slightly lower measurement precision in order to lower short-term testing costs. We believe, though, that manufacturers should be able to individually optimize their test facilities in this manner. In addition, it is important for manufacturers to understand that we will conduct our confirmatory testing in the manner specified in these regulations.

We are also proposing a new regulatory provision that specifies the steps that someone would need to follow to demonstrate that their own alternate measurement procedure is as good as or better than the procedure specified by our regulations. This provision will be the same as that finalized for highway testing, which can be found in 40 CFR 86.1306–07. The proposed test procedure changes just discussed can be found in 40 CFR Part 1065 of the proposed regulations.

G. Not-To-Exceed Requirements

EPA is proposing to adopt not-to-exceed (NTE) emission standards for new non-road diesel engines which are similar to those the Agency set for highway heavy-duty diesel engines. Specifically, the Agency proposes to adopt for non-road diesel engines NTE specifications similar to those finalized as part of the heavy-duty highway diesel engine rulemaking. These specifications are currently published in 40 CFR 86.007-11 and 40 CFR 86.1370-2007.

NTE standards are set as multipliers of FTP standards, therefore, the NTE standards are also set as emissions mass per unit work performed (i.e. brake-specific, g/kW-hr). EPA proposes that non-road NTE standards be applicable to NOx, CO, THC, and PM mass emissions from the engines subject to this proposed rule. These standards are evaluated against EPA-prescribed procedures for conducting in-use testing. Such tests may be conducted in an engine or chassis dynamometer laboratory, or they may be conducted on a piece of non-road equipment operating normally in-use by using EPA-prescribed field-testing procedures.

For new nonroad diesel engines, EPA proposes that manufacturers state in their application for certification that they are able to meet the NTE standards under all conditions that may reasonably be expected to occur in normal equipment operation and use. Manufacturers will have to maintain a detailed description of any testing, engineering analysis, and other information that forms the basis for their statement. This information may include a variety of steady-state emission measurements not included in the prescribed emission testing duty cycles. It may also include a continuous trace showing how emissions vary during the transient test or operation manufacturers believe are representative of the way their engines normally operate in the field. This data may also consist of field testing data. Any of the aforementioned data may be analyzed using the NTE data reduction procedures proposed in this regulation; with the final emissions data set then compared to the appropriate NTE standards.

EPA requests comment on an alternative NTE specification that differs from the highway NTE specification. If adopted, this would be the sole NTE test procedure for Tier 4 nonroad diesel engines. The alternative utilizes all engine operation to determine compliance. Other differences in its data reduction procedures would eliminate the need for measuring engine torque for the alternative NTE, which can be particularly difficult on-board nonroad vehicles. These alternative procedures would also eliminate the need for an absolute exhaust flow measurement for these engines by relying on a signal linearly proportional to standard exhaust flow. This alternative approach would address some concerns of the ease of practical in-use implementation of NTE testing. For more detailed information on EPA's NTE provisions, refer to Chapter 4.3 of the draft RIA for this proposal.

H. Certification Fuel

It is well-established that measured emissions may be affected by the properties of the fuel used during the test. For this reason, we have historically specified allowable ranges for test fuel properties such as cetane and sulfur content. These specifications are intended to represent most typical fuels that are commercially available in use. This helps to ensure that the emissions reductions expected from the standards occur in use as well as during emissions testing. Because we are proposing to lower the upper limit for in-use nonroad diesel fuel sulfur content to 500 ppm in 2007, and again to 15 ppm in 2010, we are also proposing to establish new ranges of allowable sulfur content for testing. These are proposed to be 300 to 500 ppm (by weight) for model year 2008 to 2010 engines, and 7 to 15 ppm (by weight) for 2011 and later model year engines. We believe that these ranges best correspond to the fuels that diesel machines will potentially see in use. (See 66 FR 5112-5113 where we adopted a similar approach to certification fuels for highway HDDEs.) These specifications will apply to emission testing conducted for certification, selective enforcement audits, in-use, and NTE testing, as well as any other laboratory engine testing for compliance purposes for engines in the designated model years. Any compliance testing of previous model year engines will be done with the fuels designated in our regulations for those model years. Note that we are allowing certification with fuel meeting the 7 to 15 ppm sulfur specification in 2010 for under 11 hp, air-cooled, hand-startable, DI engines certified under the proposed optional standard provision discussed in Section III.B.1.d.i.

It is important to note that while these specifications include the maximum sulfur level allowed for in-use fuel, we believe that it is generally appropriate to test using the most typical fuels. As for highway fuel, we expect that, under the 15 ppm maximum sulfur requirement, refineries will typically produce diesel fuel with about 7 ppm sulfur, and that the fuel could have slightly higher sulfur levels after distribution. Thus, we expect that we would use fuel having a sulfur content between 7 and 10 ppm sulfur for our emission testing. This is the same as the range we indicated would be used for HDDE engine testing in model year 2007 and later (66 FR 5002); and as with the highway fuel, should we determine that the typical in-use nonroad diesel fuel has significantly more sulfur than this, we would adjust this target upward.

We are also proposing two options for early use of the new 7 to 15 ppm diesel test fuel. The first would be available beginning in the 2007 model year for engines employing sulfur-sensitive technology. (Model year 2007 coincides approximately with the introduction of 15 ppm highway fuel.) This allowance to use the new fuel in model years before 2011 would only be available for engines which the manufacturer demonstrates will be operated in use on fuel with 15 ppm sulfur or less. Any testing that we perform on these engines would also use fuel meeting this lower sulfur specification. This optional certification fuel provision is intended to encourage the introduction of low-emission diesel technologies in the nonroad sector. These engines will be able to use the lower sulfur fuel throughout their operating life, given the early availability of this fuel under the highway program, and the assured availability of this fuel for nonroad engines by mid-2010.

Considering that our proposed Tier 4 program would subject engines under 75 hp to new emission standards in 2008 when 15 ppm maximum sulfur fuel will be readily available from highway fuel pumps (and will enter the nonroad fuel market shortly after in 2010), we believe it is appropriate to provide a second, less proscriptive, option for use of 15 ppm sulfur certification fuel. This option would be available to any manufacturers willing to take extra steps to encourage the use of this fuel before it is required in the field. We are proposing to allow the early use of 15 ppm certification fuel for 2008-2010 engines under 75 hp, provided the certifying manufacturer ensures that ultimate purchasers of equipment using these engines are informed that the use of fuel meeting the 15 ppm specification is recommended, and also recommends to equipment manufacturers buying these engines that labels be applied at the fuel inlet to remind users of this recommendation. This option would not apply to those 50-75 hp engines not being certified to the 0.22 g/bhp-hr PM standard, under the manufacturers' option discussed in Section III.B.1.a. Comment is request on whether or not application of this label should be mandatory for the equipment manufacturers, and on whether the engine manufacturers should supply the labels.

We believe that there may be a very small loss of emissions benefit from any of these engines for which the operator chooses to ignore the recommendation. This is because the engine manufacturer will be designing the engine to comply with the emissions standards when tested using 15 ppm fuel, potentially resulting in slightly higher emissions when it is not operated on the 15 ppm fuel. We also believe, however, that this is more than offset overall by the encouragement this provision provides for early use of 15 ppm fuel. We are not proposing that this option be available for engine designs employing oxidation catalysts or other sulfur-sensitive exhaust emission control devices except under the more restrictive provision for early use of 15 ppm fuel described above, involving a demonstration by the manufacturer that the fuel will indeed be used. Because these devices could potentially have very high sulfur-to-sulfate conversion rates, and because very high-sulfur fuels will still be available to some extent, we believe that allowing this provision for these engines would risk very high PM emissions until the 15 ppm nonroad fuel is introduced. Comment is requested on whether or not we should deal with early use of 15 ppm test fuel to certify catalyst-equipped engines in some other way, such as through a weighted-average emissions criterion using results from testing on both higher- and lower-sulfur fuels. We are also not proposing to make this second early 15 ppm test fuel option available for engines not subject to a new Tier 4 standard in 2008 as these engines should already be designed to meet applicable standards in earlier years without need for the 15 ppm fuel.

We are also proposing a similar provision for use of certification fuel meeting the proposed 300-500 ppm sulfur specification before the 2008 model year. We believe certification of model year 2006 and 2007 engines being designed to meet new Tier 2 or Tier 3 emission standards taking effect in those years (2006 for engines at or above 175 hp and 2007 for 100-175 hp engines) should be able to use this fuel, provided the certifying manufacturer is willing to take measures equivalent to those discussed above to encourage the early use of this fuel (a recommendation to the ultimate purchaser to use fuel with 500 ppm maximum sulfur and a recommendation to equipment manufacturers to so label their equipment). We also request comment as above on whether the labeling should be mandatory. The widespread availability of 500 ppm sulfur highway fuel, the short time that these 2006 and 2007 engines could use higher sulfur fuels if an operator were to ignore the recommendation, and the eventual use of 15 ppm sulfur fuel in most of these engines for most of their operating lives, gives us confidence that this provision to encourage early use of lower sulfur fuel would be beneficial to the environment overall. As with the proposed change to 300-500 ppm cert fuel for model years 2008-2010, engine manufacturers would design their engines to comply based on the test fuel specifications for certification and compliance testing. The change from a fuel specification for compliance testing that ranges up to 2000 ppm sulfur for Tier 2 and 3 engines to a specification of 500 ppm sulfur maximum could have some limited effect on the emissions control designs used on these Tier 2 and 3 engines, in that it would be slightly easier to meet the Tier 2 and 3 standards using the lower sulfur test fuel. In general, it is reasonable to set specifications of test fuel reflecting representative in-use fuels, and here the engines are expected to be using fuel with sulfur levels of 500 ppm or lower until 2010, and 15 ppm or lower after that. In this case, any impact on expected engine emissions from this change in test fuel for Tier 2 and 3 is expected to be slight.

We note that under current regulations manufacturers are already allowed to conduct testing with certification fuel sulfur levels as low as 300 ppm. The additional proposed provision for early use of 300-500 ppm sulfur test fuel would, however, result in any compliance testing conducted by the Agency being done with fuel meeting the 300-500 ppm specification. Likewise choice of the option for early use of 15 ppm sulfur test fuel would result in any Agency testing being done using that fuel. However, under both of these early certification fuel options involving a recommended fuel use provision, the Agency would not reject engines from in-use testing for which there was evidence or suspicion that the engine had been fueled at some time with higher sulfur fuel.

Finally, we are proposing to extend a provision adopted in the 1998 final rule. In that rule we set a 2000 ppm upper limit on the test fuel sulfur concentration for any testing to be performed by the Agency on Tier 1 engines under 50 hp and Tier 2 engines at or above 50 hp. We did not extend this provision to later model year engines at that time because we felt that more time was needed to assess trends in fuel sulfur levels for fuels used in nonroad diesels. At this time we are not aware of any additional information that would indicate that a change in this test specification is warranted. More importantly, because the fuel regulation we are proposing would make 500 ppm maximum sulfur nonroad diesel fuel available by mid-2007, Tier 3 engines at or above 50 hp (which phase in beginning in 2006) will be in the field for only 1½ years prior to the in-use introduction of 500 ppm fuel, and Tier 2 engines under 50 hp (which phase in beginning in 2004) will be in the field for at most 3½ years prior to this time. We believe it is appropriate to avoid adding the unnecessary complication of frequent multiple changes to the test fuel specification. We are therefore proposing to extend the 2000 ppm limit to testing conducted on engines until the 2008 model year when the 500 ppm maximum test fuel sulfur level takes effect as discussed above.

I. Labeling and Notification Requirements

As explained in Section III, the emissions standards contained in the proposed regulations would make it necessary for manufacturers to employ exhaust emission control devices that require very low-sulfur fuel (less than 15 ppm) to ensure proper operation. This action therefore proposes to restrict the sulfur content of diesel fuel used in these engines. However, the 2008 emissions standards would be achievable with less sensitive technologies and thus it could be appropriate for those engines to use diesel fuel with up to 500 ppm sulfur. There could be situations in which vehicles requiring either 15 ppm fuel or 500 ppm may be accidentally or purposely misfueled with higher-sulfur fuel. Any of these misfueling events could seriously degrade the emission performance of sulfur-sensitive exhaust emission control devices, or perhaps destroy their functionality altogether.

In the highway rule we adopted a requirement that heavy-duty vehicle manufacturers notify each purchaser that the vehicle must be fueled only with the applicable low-sulfur diesel fuel. We also required that diesel vehicles be equipped by the manufacturer with labels near the refueling inlet to indicate that low sulfur fuel is required.[315] We are proposing similar requirements here. Specifically, we are proposing that manufacturers notify each purchaser that the nonroad engine must be fueled only with the applicable low-sulfur diesel fuel, and ensure that the equipment is labeled near the refueling inlet to indicate that low sulfur fuel is required. We believe that these measures would help owners find and use the correct fuel and would be sufficient to address misfueling concerns. Thus, more costly provisions, such as fuel inlet restrictors, should not be necessary.

Beginning in model year 2011, the required fuel would be 15 ppm. For these engines, the label should state: "ULTRA LOW-SULFUR NONROAD DIESEL FUEL OR ON-HIGHWAY DIESEL FUEL ONLY (15 parts per million)". For model years 2008 to 2010, when the proposed test fuel would contain 300 to 500 ppm sulfur, the label should state: "LOW-SULFUR NONROAD DIESEL FUEL, ULTRA LOW-SULFUR NONROAD DIESEL FUEL, OR ON-HIGHWAY DIESEL FUEL ONLY (500 ppm maximum)". Engine manufacturers may choose during earlier model years to certify engines using test fuel with sulfur levels between 500 and 2,000 ppm. We would not require that these engines be labeled.

This approach would ensure that the proper functioning of the emission controls is not compromised by misfueling, while allowing owners flexibility with respect to in-use fuels in those cases in which their engines do not use sulfur-sensitive technologies.

For non-integrated manufacturers, the engine manufacturer will be required to provide such a label to the equipment manufacturer, which the equipment manufacturer will be required to install. Optionally, if an equipment manufacturer chooses to install its own label, the engine manufacturer will not be required to provide the label.

J. Temporary In-Use Compliance Margins

The Tier 4 standards will be challenging for diesel engine manufacturers to achieve, and will require manufacturers to develop and adapt new technologies for a large number and wide

[315] We also required that highway vehicles be labeled on the dashboard. Given the type of equipment using nonroad CI engines, we are proposing equivalent dashboard requirement here.

variety of engine platforms. Not only will manufacturers be responsible for ensuring that these technologies will allow engines to meet the standards at the time of certification, they will also have to ensure that these technologies continue to be highly effective in a wide range of in-use environments so that their engines would comply in use when tested by EPA. Furthermore, for the first time, these nonroad diesel engines will be subject to a new transient test cycle and NTE standards. However, in the early years of a program that introduces new technology, there are risks of in-use compliance problems that may not appear in the certification process or during developmental testing. Thus, we believe that for a limited number of model years after new standards take effect it is appropriate to adjust the compliance levels for assessing in-use compliance for diesel engines equipped with particulate traps or NOx adsorbers. This would provide assurance to the manufacturers that they will not face recall if they exceed standards by a small amount during this transition to clean technologies. This approach is very similar to that taken in the light-duty highway Tier 2 final rule (65 FR 6796) and the highway heavy-duty rule (66 FR 5113-5114), both of which involve similar approaches to introducing the new technologies.

Table VII.J-1 shows the in-use adjustments that we propose to apply. These adjustments would be added to the appropriate FELs (see Section VII.A) or, for engines certified to the standards without the use of credits, to the standards themselves, in determining the in-use compliance level for a given in-use hours accumulation. These adjustment levels were chosen to be roughly equivalent to the temporary in-use standard adjustments adopted for the heavy-duty highway program. Note also the limiting of these adjustments to engines certified to FELs below certain threshold levels. This is similar to the approach taken in the heavy-duty rule which applied the in-use standards only to vehicles using advanced low-emission technologies (see 66 FR 5113-5114). Our intent is that these add-on levels be available only for highly-effective advanced technologies such as particulate traps and NOx adsorbers. As in our other mobile source programs, we do not believe that the standards are stringent enough or the required technology change radical enough to warrant add-ons for other proposed standards changes (the NOx standard for 25-75 hp engines, the 2008 PM standards for engines below 75 hp, or the NMHC standards).

TABLE VII.J-1 – ADD-ON LEVELS USED IN DETERMINING IN-USE STANDARDS

<table>
<tr><th>Engine power</th><th>Model years</th><th>NOx Add-on
Level to FEL[a]
(g/bhp-hr)</th><th>PM Add-on
Level to FEL[b]
(g/bhp-hr)</th></tr>
<tr><td>25 ≤ hp < 75
(19 ≤ kW < 56)</td><td>2013-2014</td><td>none</td><td rowspan="3">0.01</td></tr>
<tr><td>75 ≤ hp < 175
(56 ≤ kW < 130)</td><td>2012-2015</td><td>0.10 for operating hours ≤ 4000
0.20 for operating hours > 4000</td></tr>
<tr><td>hp ≥ 175
(kW ≥ 130)</td><td>2011-2015</td><td>0.10 for operating hours ≤ 4000
0.20 for operating hours > 4000</td></tr>
</table>

Notes:
[a] Applicable only to those engines with FELs at or below 1.5 g/bhp-hr NOx.
[b] Applicable only to those engines with FELs at or below the Tier 4 PM standard.

Note that these in-use add-on levels apply only to engines certified through the first few model years of the new standards and having FELs below the specified levels. The in-use add-ons are available through model year 2015 for such engines above 75 hp because our proposed implementation schedule does not complete the phase-in process in these power categories until 2014. The 2015 date provides 2 years for the designers of those engine models that are last to be phased in (which may comprise upwards of 50% of sales and a large number of low-volume engine models) to discover and resolve any problems not showing up in the certification process or developmental testing.[316] This is the same period as that provided in the highway HDDE rule.

During the certification demonstration, manufacturers will still be required to demonstrate compliance with the unadjusted Tier 4 certification standards using deteriorated emission rates. Therefore, the manufacturer will not be able to use these in-use standards as the design targets for the engine. They will need to project that most engines would meet the standards in-use without adjustment. The in-use adjustments will merely provide some assurance that they would not be forced to recall engines because of some small miscalculation of the expected deterioration rates.

K. Monitoring and Reporting of Emissions Related Defects

We are proposing to apply the defect reporting requirements of §1068.501 to replace the provisions of 40 CFR part 85 for nonroad engines. The requirements obligate manufacturers to tell us when they learn that emission control systems are defective and to conduct investigations under certain circumstances to determine if an emission-related defect is present. We are also

[316] Flexibility provisions such as our ABT program and the incentive program for early or very low emission engines may result in some engines that incorporate the advanced emission control technologies even later. However, we do not believe it is appropriate to adjust the in-use compliance levels for engines on which achieving the standard is delayed by manufacturer's choice, nor did we do so in our highway HDDE program.

proposing a requirement that manufacturers initiate these investigations when warranty information, parts shipments, and any other information which is available indicates that a defect investigation may be fruitful. For this purpose, we consider defective any part or system that does not function as originally designed for the regulatory useful life of the engine or the scheduled replacement interval specified in the manufacturer's maintenance instructions. The parts and systems are those covered by the emissions warranty, and listed in Appendix I and II of part 1068.

We believe the investigation requirement proposed in this rule will allow both EPA and the engine manufacturers to fully understand the significance of any unusually high rates of warranty claims and parts replacements for parts or parameters that may have an impact on emissions. We believe that as part of its normal product quality practices prudent engine manufacturers already conduct a thorough investigation when available data indicate recurring parts failures. Such data is valuable and readily available to most manufacturers and, under this proposal it must be considered to determine whether or not there is a possible defect of an emission-related part.

Defect reports submitted in compliance with the current regulations are based on a single threshold applicable to engine families of all production volumes. No affirmative requirement for gathering information about the full extent of the problem was applicable. For very large volume engine families, the proposed approach may result in fewer total defect reports being submitted by manufacturers than the traditional approach because the number of defects triggering the submission requirement generally rises in proportion to the engine family size. The single threshold in the existing regulations results in reporting of defects in the smallest engine families covered by this regulation very rarely because a relatively high proportion of such engines would have to be known to be defective before reporting is required under a fixed threshold scheme. Therefore, under this proposal, the threshold for reporting for the smallest engine families has been decreased as compared to the current requirements.

We are aware that accumulation of warranty claims and part shipments will likely include many claims and parts that do not represent defects, so we are establishing a relatively high threshold for triggering the manufacturer's responsibility to investigate whether there is, in fact, a real occurrence of an emission-related defect. Manufacturers are not required to count towards the investigation threshold any replacement parts they require to be replaced at specified intervals during the useful life, as specified in the application for certification and maintenance instructions to the owner, because shipment of such parts clearly do not represent defects. All such parts would be excluded from investigation of potential defects and reporting of defects, whether or not any specific part was, in fact, shipped for specified replacement.

This proposal is intended to require manufacturers to use information we would expect them to keep in the normal course of business. We believe in most cases manufacturers would not be required to institute new programs or activities to monitor product quality or performance. A manufacturer that does not keep warranty or replacement part information may ask for our approval to use an alternate defect-reporting methodology that is at least as effective in identifying and tracking potential emissions related defects as the proposed requirements. However, until we approve such a request, the proposed thresholds and procedures continue to apply.

The thresholds for investigation proposed today are 4 percent of total production to date, or 4,000 engines, whichever is less, but never fewer than 40 for any single engine family in one model year. These thresholds are reduced by 50 percent for defects related to any aftertreatment devices, including particulate traps, because these components typically play such a significant role in controlling engine emissions. For example, for an engine family with a sales volume of 20,000 units in a given model year, the manufacturer would have to investigate potential emission-related defects if there were warranty claims or parts shipments for replacing electronic control units in 800 or more engines; or catalytic converters on 400 or more engines. For an engine family with sales volume of 500 units in a given model year, the manufacturer would have to investigate potential emission-related defects if there were warranty claims or parts shipments of electronic control units in 40 or more engines; or catalytic converters on 20 or more engines. Please note, manufacturers would not investigate for emission related defects until either warranty claims or parts shipments separately reach the investigation threshold. We recognize that a part shipment may ultimately be associated with a particular warranty claim in the manufacturer's database and, therefore, warranty claims and parts shipments would not be aggregated for the purpose of triggering the investigation threshold under this proposal.

In order to carry out an investigation to determine if there is an emission-related defect, manufacturers would have to use available information such as preexisting assessments of warranted parts or other replaced parts. Manufacturers would also have to gather information by assessing previously unexamined parts submitted with warranty claims and replacement parts which are available or become available for examination and analysis. If available parts are deemed too voluminous to conduct a timely investigation, manufacturers would be permitted to employ appropriate statistical analyses of representative data to help draw timely conclusions regarding the existence of a defect. These investigative activities should be summarized in the periodic reports of recently opened or closed investigations as discussed below. It is important to note that EPA does not regard having reached the investigation thresholds as conclusive proof of the existence of a defect, only that initiation of an appropriate investigation is merited to determine whether a defect exists.

The second threshold in this proposal specifies when a manufacturer must report that there is an emission-related defect. This threshold involves a smaller number of engines because each potential defect has been screened to confirm that it is an emission-related defect. In counting engines to compare with the defect-reporting threshold, the manufacturer would consider a single engine family and model year. However, when a defect report is required, the manufacturer would report all occurrences of the same defect in all engine families and all model years which use the same part. For engines subject to this proposal, the threshold for reporting a defect is 0.25 percent of total production for any single engine family, or 250 defects, whichever is less. The thresholds are reduced 50 percent for reporting defects related to aftertreatment devices. Additionally, this proposal requires a minimum of 5 defects before a report must be filed so that limited isolated parts failures that occur for low volume engine families do not require a defect report. It is important to note that while EPA regards occurrence of the defect threshold as proof of the existence of a reportable defect, it does not regard that occurrence as conclusive proof that recall or other action is merited.

If the number of engines with a specific defect is found to be less than the threshold for submitting a defect report, but information, such as warranty claims or parts shipment data, later indicates additional potentially defective engines, under this proposal the information must be aggregated for the purpose of determining whether the threshold for submitting a defect report has been met. If a manufacturer has actual knowledge from any source that the threshold for submitting a defect report has been met, a defect report would have to be submitted even if the trigger for investigating has not yet been met. For example, if manufacturers receive information from their dealers, technical staff or other field personnel showing conclusively that there is a recurring emission-related defect, they would have to submit a defect report if the submission threshold is reached.

For both the investigation and reporting thresholds, §1068.501 specifies lower thresholds for very large engines. A defect in these engines can have a much greater impact than defects in smaller engines due to their higher g/hr emission rates and the increased likelihood that such large engines will be used more continuously.

Under this proposal at specified times the manufacturer would also have to report open investigations as well as recently closed investigations that did not require a defect report. We are not proposing a fixed time limit for manufacturers to complete their investigations. The periodic reports required by the regulations, however, will allow us to monitor these investigations and determine if it is necessary or appropriate for us to take further action.

We are requesting comment on this approach, especially with respect to the thresholds. Should we adopt slightly higher thresholds for nonroad engines given their relatively small engine family sizes? Should we focus the defect reporting requirements more on aftertreatment defects since such defects will generally have more significant impacts than other defects? We are also requesting comment on whether these reporting requirements should also apply to the current Tier 2/Tier 3 compliance program, and if so, when these provisions should be applied.

L. Rated Power

We are proposing to add a definition of "maximum engine power" to the regulations. This term would be used instead of previously undefined terms such as “rated power” or “power rating” to specify the applicability of the standards. The addition of this definition is intended to allow for more objective applicability of the standards. More specifically, we are proposing that:

> Maximum engine power means the measured maximum brake power output of an engine. The maximum engine power of an engine configuration is the average maximum engine power of the engines within the configuration. The maximum engine power of an engine family is the highest maximum engine power of the engines within the family.

Currently, since rated power and power rating are undefined, they are determined by the engine manufacturer. This makes the applicability of the standards too subjective and confusing. One manufacturer may choose to define rated power as the maximum measured power output, while another may define it as the maximum measured power at a specific engine speed. Using this second approach, an engine's rated power may be somewhat less than the true maximum power output of the engine. Given the importance of engine power in defining which standards an engine must meet and when, we believe that it is critical that a singular power value be determined objectively according to a specific regulatory definition.

We are also adding a clarification to the regulations recognizing that actual engine power will vary to some degree during production. The proposed regulations would require manufacturers to specify a range of actual maximum engine power for each engine configuration. As noted above, we would base the applicability of the standards on the average maximum power of the engines.

M. Hydrocarbon Measurement and Definition

Both the existing standards and the proposed Tier 4 standards apply to nonmethane hydrocarbons, rather than total hydrocarbons. Methane emissions generally are considered to be nonreactive with respect to ozone, and are not regulated under part 89. However, excluding methane requires that it be separately measured, which complicates the measurement procedures. While we are not proposing to change the standards to total hydrocarbons we are requesting comment on the need to measure methane and the appropriateness of excluding it from our standards.

N. Auxiliary Emission Control Devices and Defeat Devices

Existing nonroad regulations prohibit the use of a defeat device (see 40 CFR 89.107) in nonroad diesel engines. The defeat device prohibition is intended to ensure that engine manufacturers do not use auxiliary emission control devices (AECD) which sense engine operation in a regulatory test procedure and as a result reduce the emission control effectiveness[317] of that procedure. In today's notice we are proposing to supplement existing nonroad test procedures with a transient engine test cycle and NTE emission standards with associated test requirements. As such, the Agency believes that a clarification of the existing nonroad diesel engine regulations regarding defeat devices is required in light of these proposed additional emission test requirements. The defeat device prohibition makes it clear that AECDs which reduce the effectiveness of the emission control system are defeat devices, unless one of several conditions is met. One of these conditions is that an AECD which operates under conditions "included in the test procedure"[318] is not a defeat device. While the existing defeat

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[317] Auxiliary emission control device is defined at 40 CFR 89.2 as " any element of design that senses temperature, vehicle speed, engine RPM, transmission gear, or any other parameter for the purpose of activating, modulating, delaying or deactivating the operation of any part of the emission control system."

[318] 40 CFR 89.107(b)(1) states "Defeat device includes any auxiliary emission control device (AECD) that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal operation and use unless such conditions are included in the test procedure."

device definition does contain the term “test procedure”, and therefore should be interpreted as including the supplemental testing requirements, we want to make it clear that both the supplemental transient test cycle and NTE emission test procedures are included within the defeat device regulations as conditions under which an operational AECD will not be considered a defeat device. Therefore, we are proposing to clarify the defeat device regulations by specifying the appropriate test procedures (i.e., the existing steady-state procedures and the supplemental tests).

We are also proposing today to provide clarification regarding the engine manufacturers certification reporting requirements with respect to the description of AECDs. The proposed clarification will aid engine manufacturers in preparing a complete application for certification which will allow EPA to review the application in a timely manner. Under the existing nonroad engine regulations, manufacturers are required to provide a generalized description of how the emissions control system operates and a “detailed” description of each AECD installed on the engine (See 40 CFR 89.115(d)(2)). This proposal is intended to clarify what is meant by “detailed.”

Under the nonroad diesel Tier 1 standards there was limited use of AECDs. AECDs have begun to be much more common with the Tier 2 standards, and we expect this trend to continue. Engines designed to meet the significantly more stringent Tier 4 standards will certainly rely on sophisticated technologies that will likely employ very complex AECDs. We have seen a similar trend with highway heavy-duty diesel engines. In the late 1980's, few highway HDDEs had electronic controls and most manufacturers relied on in-cylinder techniques to control emissions. However, with the application of technologies such as electronically controlled fuel systems, electronically controlled EGR systems, and variable geometry turbochargers, highway HDDEs now have numerous AECDs which are used both for performance as well as emissions control.

A thorough disclosure of the presence and purpose of AECDs is essential in allowing EPA to evaluate the AECD and determine whether it represents a defeat device. Clearly, any AECD which is not fully identified in the manufacturer’s application for certification cannot be appropriately evaluated by EPA and therefore cannot be determined to be acceptable by EPA. Our proposed clarifications to the certification application requirements include additional detail specific to those AECDs which the manufacturer believes are necessary to protect the engine or the equipment in which it is installed against damage or accident (“engine protection” AECDs). While the definition of a defeat device allows as an exception strategies needed to protect the engine and equipment against damage or accident, we intend to continue our policy of closely reviewing the use of this exception. In evaluating whether a reduction in emissions control effectiveness is needed for engine protection, EPA will closely evaluate the actual technology employed on the engine family, as well as the use and availability of other emission control technologies across the industry, taking into consideration how widespread the use is, including its use in similar engines and similar equipment. While we have specified additional information related to engine protection AECDs in the proposed regulations, we reserve the right to request additional information on a case-by-case basis as necessary.

In the last several years, EPA has issued extensive guidance on the disclosure of AECDs for both highway and nonroad diesel engine manufactures.[319] This proposal does not impose any new certification burden on engine manufacturers, rather, it clarifies the existing certification application regulations by specifying what type of information manufacturers must submit regarding AECDs.

Finally, we take this opportunity to emphasize that the information submitted must be specific to each engine family. The practice of describing AECDs in a "common" section, wherein the strategies are described in general for all the manufacturer's engines, is acceptable as long as each engine family's application contains specific references to the AECDs in the common section which clearly indicate which AECDs are present on that engine family, and the application contains specific calibration information for that engine family's AECDs. The proposed regulatory requirements can be found at 40 CFR 89.115(d)(2) in today's notice.

We are requesting comment on whether these clarifications should also be applied to the current Tier 2/Tier 3 compliance program, and if so, when these provisions should be applied.

O. Other Issues

We are also proposing other minor changes to the compliance program for Tier 4 nonroad engines. For example, we are proposing that engine manufacturers be required to provide installation instructions to equipment manufacturers to ensure that engine cooling systems, aftertreatment exhaust emission controls, and related sensors are properly installed by the equipment manufacturer. Proper installation of these systems is critical to the emission performance of the equipment. Equipment manufacturers would be expected to follow the instructions to avoid improper installation that could render emission controls inoperative, and subject the equipment manufacturer to penalties for t violation of a prohibited act.

Under the existing regulations and the proposed new regulations, engine manufacturers are responsible for all emission-related components, both in terms of emission performance during certification and in-use testing, and emission-related warranties. This requires that engine manufacturers provide their engines with the necessary emission controls before selling them to equipment manufacturers. We are proposing to use the same approach as is used with highway engines, where the engine manufacturer is required to either install catalysts or traps before selling the engine to a vehicle manufacturer, or to ship the catalyst or trap with the engine, with appropriate installation instructions. We are requesting comment on whether this is appropriate for nonroad engines equipped with traps and other aftertreatment exhaust emission controls. We are concerned that allowing engine manufacturers to sell engines without traps included might

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[319] See EPA Dear Manufacturer Letter VPCD-98-13, "Heavy-duty Diesel Engines Controlled by Onboard Computers: Guidance on Reporting and Evaluating Auxiliary Emission Control Devices and the Defeat Device Prohibition of the Clean Air Act", October 15, 1998 and EPA Advisory Circular 24-3, "Implementation of Requirements Prohibiting Defeat Devices for On-Highway Heavy-Duty Diesel Engines." A copy of both of these documents is available in EPA Air Docket A-2001-28

lead to equipment being introduced into service without the emission controls properly installed. We are requesting comment on whether it is sufficient to require manufacturers to fully describe in their installation instructions all necessary emission control hardware , and whether the engine manufacturer should be held responsible for ensuring the aftertreatment is properly installed, including requiring some management by the engine manufacturers of the installation process, such as auditing the installations and reporting the results to EPA.

In §89.109, we limit the amount of maintenance that manufacturers can perform during service accumulation. We are proposing to continue these limits in the proposed new section§1039.125. However, we are not carrying over the provisions of §89.109(h)(2)(iii) and (iv) that are related to allowances for additional maintenance for engines equipped with onboard diagnostic systems that include visible warning lights. We believe that these provisions would be better addressed in a rulemaking addressing onboard diagnostic standards.

Both the existing regulations and the proposed regulations specify default criteria to define engine family groups, but allow exceptions for cases where other groups would more appropriately represent similar emission characteristics. The proposed regulations specify the same criteria as part 89, plus two new criteria. we are proposing that mechanically controlled engines and electronically controlled engines generally be certified in separate engine families. We are also proposing that engines in different power categories generally must be in separate engine families.

We are proposing to clarify the applicability of the nonroad CI standards to engines operating on alcohols and other oxygenated fuels. As part of this, we are proposing to add a requirement that compression-ignition alcohol-fueled engines be required to comply with the evaporative emission control requirements in 40 CFR 1048.105. That section allows manufacturers to comply with the requirement by incorporating simple emission controls. This requirement is not expected to have a significant impact on manufacturers since we are not aware of any alcohol-fueled nonroad engines currently in production. The proposed provision is merely intended to prevent new emission problem from occurring in the future.

We are proposing to change the way in which manufacturers specify deterioration factors (DFs) for Tier 4 trap-equipped engines. The current regulations specify that the DFs for engines with aftertreatment devices must be multiplicative . They must be expressed as a proportion of the engine's initial emission rate. Manufacturers have indicated in past discussions that, given the general operating mechanism of PM traps and the very low PM levels emitted, trap deterioration is not expected to depend on the initial emission rate, as increased emissions from deterioration that tend to be non-sulfate PM, and therefore not related to the initial emissions rate. Therefore, we are proposing to specify additive DFs for PM that account for a fixed amount of deterioration and are independent of the engine's initial emission rate.

We are proposing to extend to CI engines that operate on unrefined natural gas the same provisions we have adopted for similar SI engines. Such engines are sometimes used to operate pumps at oil fields where unrefined natural gas is a readily available and inexpensive fuel source.

This provision would allows manufacturers greater flexibility with respect to engine adjustment to address variability in fuel properties.

In addition, we are proposing to require that manufacturers label uncertified engines that they import for stationary applications. Because these engines look the same as or very similar to regulated nonroad engines, it can be difficult to distinguish the two without labels. These labels will also help manufacturers and others who import these engines to avoid potential problems with customs inspections.

Another labeling issue relates to the primary emission control information label that engine manufacturers put on every certified engine they produce. The current regulations require equipment manufacturers to put a duplicate label on the equipment if the engine is installed in a way that obscures the label on the engine. We are proposing to clarify this requirement for duplicate labels to ensure that labels are accessible without creating a supply of duplicate labels that are not authentic and used appropriately. Specifically, we are proposing to require engine manufacturers to supply duplicate labels to equipment manufacturers that request them and keep records to show how many labels they supply. Similarly, we are proposing to require equipment manufacturers to request from engine manufacturers a specific number of duplicate labels, with a description of which engine and equipment models are involved and why the duplicate labels are necessary. Equipment manufacturers would need to destroy any excess labels and keep records to show the disposition of all the labels they receive. We request comment on these provisions. In addition, we request comment on an alternative approach to labeling equipment. If equipment manufacturers were required to add a label to each piece of equipment with basic information related to the engine's emission controls, the information would be most accessible in all situations. Such a label would need to at least identify the engine manufacturer, engine family and serial number, manufactured date, power rating, and any important engine specifications. This would make it easier for us to verify that engines are meeting requirements and it would be easier for U.S. Customs (Bureau of Customs and Border Protection) to clear imported equipment with certified engines. Note that some equipment manufacturers have already been voluntarily attaching such labels or plates to their equipment. We request comment on a uniform requirement to apply labels to equipment using nonroad diesel engines to uniquely identify the installed engine.

We are also clarifying the general requirement that all engines subject to this final rule may not cause or contribute to an unreasonable risk to public health, welfare, or safety, especially with respect to noxious or toxic emissions that may increase as a result of emission-control technologies. The proposed regulatory language, which addresses the same general concept as the existing §89.106, implements sections 202(a)(4) and 206(a)(3) of the Act and clarifies that the purpose of this requirement is to prevent control technologies that would cause unreasonable risks, rather than to prevent trace emissions of any noxious compounds. This requirement prevents the use of emission-control technologies that produce high levels of pollutants for which we have not set emission standards, but nevertheless pose a risk to the public.

In the part 89 regulations we use the same definition for "aircraft" as is used in 40 CFR part 87. The definition, which is used to exclude aircraft engines from the part 89 regulations, states that aircraft means “any airplane a U.S. airworthiness certificate or equivalent foreign airworthiness certificate has is issued.” We are proposing to use this same definition for the new part 1039 regulations. We believe that this definition encompasses all vehicles that are capable of sustained air travel above treetop heights using compression ignition engines. We request comment on whether there are any aircraft that do not meet this definition, and use compression-ignition engines, but that should not be regulated under part 1039.

Finally, we are not revising at this time the regulation on preemption of state and local controls currently found in Part 89. This regulation will continue in effect. We are, however, considering whether we should clarify the binding regulatory nature of this language, consistent with the decision of the court in Engine Manufacturers Association v. EPA, 88 F.3d 1075 (D.C.Cir. 1996).

VIII. Nonroad Diesel Fuel Program: Compliance and Enforcement Provisions

Section IV above describes the proposed program for the reduction of sulfur in nonroad, locomotive and marine (NRLM) diesel fuel. In general, this proposal would require refiners and importers to meet a 500 ppm sulfur standard for nonroad, locomotive, and marine diesel fuel starting June 1, 2007 and to meet a 15 ppm standard for nonroad diesel fuel beginning June 1, 2010. Locomotive and marine diesel fuel would remain subject to the 500 ppm standard. Among other provisions, Section IV also describes a temporary non-highway distillate baseline percentage method to differentiate volumes of diesel fuel subject to the NRLM standards and volumes of diesel fuel subject to the highway fuel standards; provisions to identify unregulated fuel such as heating oil; provisions for diesel fuel credit generation and use; and special provisions for small refiners, refiners seeking hardship relief, and parties supplying diesel fuel to Alaska and U.S. territories.

As with earlier fuel programs, we have developed a comprehensive set of compliance and enforcement provisions designed to promote effective and efficient implementation of this fuel program and thus to achieve the full environmental potential of the program. The proposed compliance provisions are designed to ensure that nonroad, locomotive, and marine diesel fuel sulfur content requirements are met throughout the distribution system, from the refiner or importer through the end user, subject to certain provisions applicable during the early transition years. Several of these provisions are described in Section IV above, and others are summarized in this section. The full details of all proposed provisions are found in the regulatory language associated with today's notice.

The proposed compliance and enforcement provisions discussed in this section fall into several broad categories:

- Fuel uses covered and not covered under the proposed program;
- Provisions not described in Section IV applicable to refiners and importers;
- Provisions not described in Section IV applicable to parties downstream of the refinery or importer;
- Special provisions regarding additives, kerosene, and the use of motor oil in fuel;
- Fuel testing and sampling requirements;
- Records required to be kept (including those applying under the small refiner and refiner hardship provisions);
- Reporting requirements;
- Exemptions from the program; and
- Provisions concerning liability, defenses, and penalties for noncompliance.

A. Fuel Covered and Not Covered by this Proposal

1. Covered Fuel

As discussed in Section IV.A.1 above, this proposed standards generally cover all the diesel fuel that is intended or likely to be used in nonroad, locomotive, and marine (NRLM) applications that is not already covered by the standards for highway diesel fuel. For the purposes of this preamble, this fuel is defined primarily by the type of engine which it is used to power: land-based nonroad, locomotive, and marine diesel engines.

2. Special Fuel Provisions and Exemptions

Section IV.A.1 above also describes several types of petroleum distillate that are not covered by this proposal, including jet fuel and heating oil. In addition, the next paragraphs discuss several provisions and exemptions for nonroad diesel fuel that we propose to apply in special circumstances.

a. Fuel Used in Military Applications

We propose to treat NRLM diesel fuel used in military applications in the same manner as the recent highway diesel rule. We propose to define NRLM diesel fuel so that JP-5 and JP-8 military fuel that is used or intended for use in NRLM diesel engines would be subject to all of the requirements applicable to NRLM diesel fuel. However, we also propose to exempt JP-5 and JP-8 fuels from the proposed diesel fuel content and other requirements in certain circumstances. First, these fuels would be exempt if they were used in tactical military equipment that have a national security exemption. Due to national security considerations, EPA's existing regulations allow the military to request and receive national security exemptions (NSE) for their NRLM diesel engines from emissions regulations if the operational requirements for such engines warrant such an exemption. This proposal would not change these provisions. Second, these fuels would also be exempt if they were used in tactical military equipment that is not covered by a national security exemption but for national security reasons, needs to be fueled on the same fuel as motor vehicles or nonroad equipment with a national security exemption such as the need to be ready for immediate deployment overseas. Use of JP-5 and JP-8 fuel not meeting the proposed NRLM diesel fuel standards in a NRLM diesel engine other than the tactical military equipment described above would be prohibited under today's rule.

EPA and the Department of Defense will develop a process to address the tactical nonroad equipment to be covered by the diesel fuel exemption. Based on data provided by the Department of Defense to date in the context of implementing a similar exemption provision in the highway program, EPA believes that providing an exemption for JP-5 and JP-8 fuel used in tactical nonroad equipment would not have any significant environmental impact.

b. Fuel Used in Research and Development

This proposed rule would permit parties to request an exemption from the sulfur or other standards for NRLM diesel fuel used for research, development and testing purposes (“R & D exemption”). We recognize that there may be legitimate research programs that require the use of diesel fuel with higher sulfur levels than allowed under this proposed rule. As a result, this proposal contains provisions for obtaining an exemption from the prohibitions for persons distributing, transporting, storing, selling, or dispensing NRLM diesel fuel that exceeds the standards, where such diesel fuel is necessary to conduct a research, development, or testing program.

Under the proposed rule, parties seeking an R & D exemption would be required to submit an application for exemption to EPA that describes the purpose and scope of the program, and the reasons why higher-sulfur diesel fuel is necessary. Upon presentation of the required information, an exemption could be granted at the discretion of the Administrator, with the condition that EPA could withdraw the exemption in the event the Agency determines the exemption is not justified. In addition, an exemption based on false or inaccurate information could be considered void *ab initio*. Fuel subject to an exemption would be exempt from certain provisions of this proposed rule, including the sulfur standards, provided certain requirements are met. These requirements include the segregation of the exempt fuel from non-exempt NRLM and highway diesel fuel, identification of the exempt fuel on product transfer documents, pump labeling, and where appropriate, the replacement, repair, or removal from service of emission systems damaged by the use of the high sulfur fuel.

c. Fuel Used in Racing Equipment

This proposed rule would provide no exemption from the sulfur or other content standard and other requirements of the proposal for diesel fuel used in racing. Under certain conditions, racing vehicles would not be considered nonroad vehicles. See, for example, 40 CFR 89.2, definition of "nonroad vehicle". The fuel used by such racing vehicles would not necessarily be considered nonroad diesel fuel. However, we believe that there is a realistic chance that such fuel also could be used in NRLM equipment, and therefore, should be considered NRLM diesel fuel. During the highway diesel rulemaking, we received no comments supporting the need for an exemption for racing fuel. We are not aware of any advantage for racing vehicles or racing equipment to use fuel having higher sulfur levels than are required by this proposed rule, and we are concerned about the potential for misfueling of nonroad equipment and motor vehicles that could result from having a high sulfur (*e.g.*, 3,400 ppm) fuel for vehicle or nonroad equipment available in the marketplace. Consequently, as was the case with the highway diesel rule, this proposal does not provide an exemption from the nonroad diesel fuel requirements for fuel used in racing vehicles or equipment.

d. Fuel for Export

Fuel produced for export, and that is actually exported for use in a foreign country, would be exempt from the fuel content standards and other requirements of this proposed rule, such as the non-highway baseline provisions. Such fuel would be considered as intended for use in the U.S. and subject to the proposed standards unless it was designated by the refiner as for export only and product transfer documents stated that the fuel was for export only. Fuel intended for export would need to be segregated from all fuel intended for use in the U.S., and distributing or dispensing such fuel for domestic use would be illegal.

B. Additional Requirements for Refiners and Importers

The primary requirements proposed today for refiners and importers are discussed in Section IV above. In that section, we discuss the general structure of the compliance and enforcement provisions applicable to refiners and importers, including fuel content standards, baseline provisions, and credit provisions. In this subsection, we discuss several additional requirements for refiners and importers that are not addressed in Section IV. In addition, Sections VIII.D, E, and F below discuss several provisions that apply to all parties in the diesel fuel production and distribution system, including refiners and importers.

1. Transfer of Credits

This proposal includes provisions for diesel sulfur credit transfers that are essentially identical to other fuels rules that have credits provisions. As in other fuels rules, nonroad diesel sulfur credits could only be transferred between the refiner or importer generating the credits and the refiner or importer using the credits. If a credit purchaser could not use all the credits it purchased from the refiner who generated them, the credits could be transferred one additional time. We recognize that there is potential for credits to be generated by one party and subsequently purchased and used in good faith by another party, where the credits are later found to have been calculated or created improperly, or otherwise found to be invalid. As with the reformulated gasoline rule, the Tier 2/Gasoline Sulfur rule, and the highway diesel rule, invalid credits purchased in good faith would not be valid for use by the purchaser. To allow such use would not be consistent with the environmental goals of the regulation. In addition, both the seller and purchaser of invalid credits would have to adjust their credit calculations to reflect the proper credits and either party (or both) could be deemed in violation if the adjusted calculations demonstrated noncompliance. The parties to such a credit transaction can be expected to develop contractual provisions to address these circumstances.

Nevertheless, in a situation where invalid credits are transferred, our strong preference would be to hold the credit seller liable for the violation, rather than the credit purchaser. As a general matter we would expect to enforce a shortfall in credit compliance calculations against the credit seller, and we would expect to enforce a compliance shortfall (caused by the good faith purchase of invalid credits) against a good faith purchaser only in cases where we are unable to recover sufficient valid credits from the seller to cover the shortfall. Moreover, in settlement of such cases we would strongly encourage the seller to purchase credits to cover the good faith purchaser’s credit shortfall. EPA would consider the covering of a credit deficit through the purchase of valid credits a very important factor in mitigation of any case against a good faith purchaser, whether the purchase of valid credits is made by the seller or by the purchaser.

2. Additional Provisions for Importers and Foreign Refiners Subject to the Credit Provisions or Hardship Provisions

Since this proposed rule includes several compliance options that could be used by NRLM diesel fuel importers and foreign refiners, we are also proposing specific compliance and enforcement provisions to ensure compliance for imported NRLM diesel fuel. These additional foreign refiner provisions are similar to those under the conventional gasoline regulations, the gasoline sulfur regulations and the highway diesel fuel regulations (see 40 CFR 80.94, 80.410 and 80.620).

Under this proposal, standards for NRLM diesel fuel produced by refineries owned by foreign refiners must be met by the importer, unless the foreign refiner has been approved to produce NRLM diesel fuel under the credit provisions, small refiner provisions or hardship provisions of this proposal. If the foreign refiner is approved under any of these provisions , the volume requirements would be met by the foreign refiner's refinery(s) and the foreign refinery(s) would be the entity(s) generating, using, banking or trading credits for the NRLM diesel fuel produced for and imported into the U.S. We are proposing that importers themselves not be eligible for small refiner or hardship relief. Importers may participate in the proposed credit programs; however, an importer and a foreign refiner may not generate credits for the same fuel.

Any foreign refiner that applies for and obtains approval to produce NRLM diesel fuel subject to credit provisions, small refiner provisions or the hardship provisions would be subject to the same requirements as domestic refiners operating under the same provisions. Additionally, we are proposing provisions for foreign refiners similar to the provisions at 40 CFR 80.94, 80.410, and 80.620, which include:

- Segregation of NRLM diesel fuel produced at the foreign refinery until it reaches the U.S. and separate tracking of volumes imported into each PADD;
- Controls on product designation;
- Load port and port of entry testing; and
- Requirements regarding bonds and sovereign immunity.

These provisions would aid the Agency in tracking NRLM diesel fuel from the foreign refinery to its point of import into this country. We believe these provisions would be necessary and sufficient to ensure that foreign refiners’ compliance could be monitored and that the proposed diesel fuel requirements could be enforced against foreign refiners. For more discussion of the rationale for these enforcement provisions, see preamble to the final Anti-Dumping Foreign Refiners rule (see 62 FR 45533, Aug. 28, 1997) and the gasoline sulfur rule (see 65 FR 6698, February 10, 2000).

3. Proposed Provisions for Transmix Facilities

In the petroleum products distribution system, certain types of interface mixtures in product pipelines cannot be added in any significant quantity to either of the adjoining products that produced the interface. These mixtures are known as "transmix." The pipeline and terminal industry's practice is to transport transmix via truck, pipeline, or barge to a facility with an on-site fractionator that is designed to separate the products. The owner or operator of such a facility is called a "transmix processor." Such entities are generally considered to be a refiner under existing EPA fuel regulations.

Under the non-highway baseline percentage approach proposed in today's diesel rule, absent special treatment transmix processors that wished to commingle highway and NRLM fuel would need to comply with the baseline percentage requirements. Transmix processors, as with conventional refiners, are also currently subject to the "80 percent/20 percent" production requirements for 15 ppm and 500 ppm highway diesel fuel. In both of these cases, producing fuel in set percentages appears to be inconsistent with the inherent nature of the transmix processors' business. Unlike conventional refiners, transmix processors refine shipments of fuel that vary in volume and timing -- largely unpredictably. Complying with set percentages of different highway and NRLM sulfur grades would be very difficult, probably resulting in either a need to purchase credits or to postpone processing of some shipments.

In light of this disproportionate burden on transmix processors, we propose that transmix processors could choose to not be covered by both the proposed non-highway baseline provision and the TCO provisions for highway diesel fuel. This would only be an option for diesel fuel produced according to typical operational practices involving separation of transmix and not, for example, diesel fuel produced due to the blending of blend stocks. If the processor chooses not to be covered by these provisions, then the processor could produce highway or NRLM diesel fuel without these limits on production or percentages. For example, the processor could choose whether to produce 15 ppm highway, 500 ppm highway, 500 ppm NRLM, or 15 ppm NR in any proportions, during the time periods when the non-highway baseline volume percentage or the highway TCO are applicable. We are concerned that to discourage abuse, some reasonable limit on a transmix processor's production volume that could be exempted from the requirements may be necessary. Thus, we propose to limit it to 105% of its 2003-2005 average production but seek comment on whether additional flexibility is warranted.

The processor would still need to properly designate its fuel with the proper product transfer documents and, in the case of heating oil between 2007 and 2014 and locomotive and marine fuel between 2010 and 2014, to apply the specified marker and comply with other reporting and record keeping requirements applicable to refiners. A processor choosing this approach would not be eligible to generate or use NRLM or highway sulfur credits.

Because the volume of fuel involved would be small and the fuel processed would already have been "off-spec," we believe that providing these options for transmix processors would have essentially no environmental impact and would not affect the efficient functioning of the proposed program or the existing highway diesel program. Rather, these options would allow fuel volume to remain in the highway and/or NRLM markets that might otherwise be forced into the heating oil market.

4. Highway or Nonroad Diesel Fuel Treated as Blendstock (DTAB)

Under the proposed program, a situation could arise for importers where that was expected to comply with the 15 ppm NR or highway standard is found to be slightly higher in sulfur than the standard. Rather than require that importer to account for, and report, that fuel as 500 ppm fuel, we propose to allow the importer to designate the non-complying fuel as blendstock -- "diesel fuel treated as blendstock" or DTAB -- rather than as either highway or nonroad diesel fuel. In its capacity as a refiner, the party could blend this DTAB fuel with lower sulfur diesel fuel to cause the sulfur level of the combined product to meet the 15 ppm nonroad or highway standard.

Where previously certified diesel fuel is used to reduce the sulfur level of the DTAB to 15 ppm or less, the party, in its refiner capacity, would report only the volume of the imported DTAB as the amount of diesel fuel produced. This avoids the double counting that would result if the same diesel fuel is reported twice. If the product that is blended with the DTAB is not previously certified diesel fuel, but is also blendstock, the total combined volume of the DTAB and other blendstock would constitute the batch produced.

When an importer classifies diesel fuel as DTAB, that DTAB would not count toward the importer's calculations under the highway diesel rule's temporary compliance option, toward credit generation or use, or for compliance calculations under the non-highway baseline approach.[320] The same party, however, would include the DTAB in such calculations in its capacity as refiner. We believe such an approach would increase the supply of 15 ppm fuel by reducing the volume of near-compliant fuel that is downgraded to higher sulfur designations. In essence, it allows importers the same flexibility that refiners have within their refinery gate.

C. Requirements for Parties Downstream of the Refinery or Import Facility

In order for the environmental benefits of the proposed program to be ensured, parties in the fuel distribution system downstream of the refinery (including pipelines, terminals, bulk plants, wholesale purchaser-consumers, and retailers) must in most cases keep the various grades of fuel in the system separate. Owners and operators of nonroad diesel equipment must also be required in certain circumstances to use fuels meeting specific sulfur content standards. The following paragraphs discuss several provisions that we propose to apply to these parties: segregation of various fuel sulfur grades; diesel fuel pump labeling; use of used motor oil in diesel fuel; use of kerosene in diesel fuel; use of additives in diesel fuel; requirements for end users; and

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[320] Importer/refiners availing themselves of the DTAB provisions would still be subject to the non-highway distillate baseline provisions, downgrading provisions, and other provisions applicable to any importer or refiner.

provisions covering downgrading of undyed diesel fuel to different grades of fuel. These provisions are analogous to similar provisions that apply to highway diesel fuel under the highway program.

1. Product Segregation and Contamination

This subsection discusses the various grades and uses of NRLM fuel under the proposed program and when these fuel grades must be segregated from each other. In later subsections, we discuss related requirements for product transfer documents to identify fuels throughout the distribution system and provisions relating to the liability all parties in the distribution face for preventing contamination of these different fuel sulfur grades.

a. The Period From June 1, 2007 through May 31, 2010

Starting June 1, 2007, NRLM fuel having a sulfur content exceeding 500 ppm that is produced or imported under the credit, small refiner, or hardship provisions would need to be segregated from other NRLM fuel subject to the 500 ppm standard, until the point where IRS dye is added. After that point the 500 ppm NRLM fuel could be mixed with NRLM small refiner, hardship or credit fuel, but could not be mixed with heating oil without changing the designation to heating oil. However, during this period there would also be nonroad equipment equipped with engines subject to emission standards, where some of this equipment is expected to be equipped with sulfur sensitive technology that needs to operate on 500 ppm or less sulfur fuel in order to meet the proposed emission standards in-use. Fuels sold for use in, or dispensed into, these engines would need to be identified as meeting the 15 ppm standard or the 500 ppm standard, as applicable, and if so identified it would need to meet such standard, and avoid being contaminated with higher sulfur fuels.

We are proposing an additional segregation requirement for heating oil. As provided in Section IV of the preamble, such fuel would be required to be identified by a marker and segregated throughout the distribution system to the end user. It could not be used as nonroad, locomotive or marine fuel but could only be used as heating oil. NRLM fuel could, however, be used as heating oil. To be able to effectively enforce the segregation of heating oil, we are proposing that heating oil be marked by the refiner or importer by the addition of 6 mg/L of solvent yellow 124.

b. The Period From June 1, 2010 through May 31, 2014

Because of the extreme sulfur sensitivity of the expected engine emission control systems beginning in model year 2011 for nonroad diesel engines, it would be imperative that the distribution system segregate nonroad diesel fuel subject to the 15 ppm sulfur standard from higher sulfur distillate products, such as 500 ppm diesel fuel produced by small refiners or through the use of credits, heating oil, and jet fuel.

We are also concerned about potential misfueling of engines requiring 15 ppm fuel at retail or wholesale purchaser-consumer facilities as defined under this proposal, or other end-user facilities, even when segregation of 15 ppm fuel from the higher-sulfur grades of diesel fuel has been maintained in the distribution system. Thus, downstream compliance and enforcement provisions of the proposed rule are aimed at both preventing contamination of nonroad diesel fuel subject to the 15 ppm sulfur standard and preventing misfueling of new nonroad equipment.

As proposed in Section IV above, small refiners would be able to continue to produce 500 ppm nonroad fuel, until June 1, 2014. Other refiners could also produce fuel under the 500 ppm nonroad standard, through the use of credits, but only until June 1, 2012. In either case, we are proposing that during this period the 500 ppm fuel must be segregated from 15 ppm nonroad fuel throughout the distribution system, including the end user. We are also proposing that refiners and importers wishing to distribute 500 ppm nonroad diesel fuel during this period be required to petition the Agency for approval of a plan demonstrating the segregation of such fuel. The plan would also be required to include a quality assurance program that would ensure that the 500 ppm fuel would not cause fuel subject to the 15 ppm standard to be contaminated, and to ensure that model year 2011 and later nonroad diesel engines would not be misfueled.

As discussed in Section IV above, we propose that during this period, locomotive and marine fuel be segregated using the same marker as was used for heating oil before June 1, 2010. During this time, heating oil would not be marked but would be segregated based on its sulfur content, since no other fuel could exceed 500 ppm.

c. After May 31, 2014

After all regulatory flexibilites have expired, the three remaining fuels (15 ppm highway and nonroad fuel, 500 ppm locomotive and marine fuel, and heating oil) would be segregated based on their sulfur content and identifying information on product transfer documents.

2. Diesel Fuel Pump Labeling to Discourage Misfueling

For any multiple-fuel program like the two-step program proposed today, we believe that the clear labeling of nonroad diesel fuel pumps would be vital so that end users could readily distinguish between the several grades of fuel that may be available at fueling facilities, and properly fuel their nonroad equipment. Section VII above describes the labels that manufactures would be required to place on model year 2011 and later nonroad equipment, and information that would be provided to nonroad equipment owners. Today’s proposal includes requirements for labeling fuel pump stands at retail facilities, including bulk plants or portable fuel storage facilities used as a fueling facility, and wholesale purchaser-consumer facilities.

To help prevent misfueling of nonroad, locomotive and marine engines, and to thus assure the environmental benefits of the program are realized, we are proposing pump labeling requirements similar to those adopted in the highway diesel rule (40 CFR 80.570). These labels would apply to diesel fuel dyed for tax purposes, and thus generally could not be used in highway vehicles. The proposed fuel pump dispenser labeling requirements would supersede the non-highway labeling requirement established by the highway diesel rule on June 1, 2007. These pump dispenser labeling requirements are discussed separately for each of four time periods: Beginning June 1, 2006, June 1, 2007–August 31, 2010; September 1, 2010- August 31, 2014; and September 1, 2014 forward.

We are also proposing to amend the pump dispenser labeling language in the highway diesel regulations for consistency with this proposal. Because the highway diesel rule prohibits highway diesel fuel with sulfur levels above 500 ppm, the highway diesel rule and this proposal have different meanings for the terms "low sulfur" and "high sulfur", and the highway diesel rule does not use the term "ultra low-sulfur." Further, because the highway diesel rule did not need to categorize the different uses of non-highway diesel fuel, the highway diesel rule and this proposal have different meanings for the term "nonroad".[321] The proposed amendments to the highway pump dispenser labeling language are to avoid confusion at the fuel pumps caused by labels with terms that would otherwise have different meanings depending on whether the pump dispenser is designated to dispense highway or non-highway diesel fuel. We are also proposing to add effective dates to each paragraph of the labeling provisions of the highway diesel rule for consistency with the additional pump labeling sections of this proposal, and to distinguish the non-highway labeling requirement effective June 1, 2006 under the highway diesel rule from the non-highway labeling requirements of this proposal effective 2007.

a. Pump Labeling Requirements for 2006

We propose to amend the pump dispenser labeling language of the highway diesel rule for consistency with this proposal, and to avoid confusion at the fuel pumps caused by labels with terms that would otherwise have different meanings depending on whether the pump dispenser is dispensing highway or non-highway diesel fuel.

For pumps dispensing highway diesel fuel subject to the 500 ppm sulfur standard of § 80.520(c), we propose that the label read as follows:

LOW-SULFUR HIGHWAY DIESEL FUEL (500 ppm Maximum)
WARNING
May damage model year 2007 and later highway vehicles and engines.
Federal Law *prohibits* use in these vehicles

For pumps dispensing highway diesel fuel subject to the 15 ppm sulfur standard of § 80.520(a)(1), we propose that the label read as follows:

[321] In the highway diesel rule, the term "high-sulfur" means diesel fuel with a sulfur level greater than 15 ppm, whereas in this proposal it means diesel fuel with a sulfur level greater than 500 ppm. In the highway diesel rule, the term "low-sulfur" means diesel fuel with a sulfur level of no greater than 15 ppm, whereas in this proposal it means diesel fuel with a sulfur level of no greater than 500 ppm. In addition, the term "nonroad" as used in the highway diesel rule means "non-highway" (i.e., all fuel that is not highway fuel), but the term "nonroad" as used in this proposal excludes locomotive diesel, marine diesel and heating oil.

ULTRA LOW-SULFUR HIGHWAY DIESEL FUEL (15 ppm Maximum)
Recommended for use in all diesel vehicles and engines.
Required for model year 2007 and later highway diesel vehicles and engines.

For pumps dispensing diesel fuel for non-highway equipment that does not meet the standards for motor vehicle diesel fuel, we propose that the label read as follows:

NON-HIGHWAY DIESEL FUEL (May Exceed 500 ppm Sulfur)
WARNING
May damage or destroy highway engines and their emission controls.
Federal Law *prohibits* use in any highway vehicle or engine

b. Pump Labeling Requirements for 2007-2010

As discussed in Section IV of the preamble, between June 1, 2007 and August 31, 2010, this proposal would not require end users to dispense fuel meeting the 500 ppm sulfur standard into nonroad, equipment, locomotives or marine vessels. During this time period, small refiner fuel and fuel produced under the credit provisions with sulfur levels exceeding 500 ppm would still exist in the distribution system. Furthermore, this fuel could be mixed downstream at the point where the fuels are dyed for IRS tax purposes with fuel meeting the 500 ppm standard and introduced into nonroad, locomotive and marine engines. During this time period, there would also be nonroad equipment with engines subject to "pull-ahead" emission standards (i.e., engines equipped with emission controls that allow them to meet standards earlier than required). Some of this pull-ahead equipment is expected to be equipped with sulfur sensitive technology that would need to operate on fuel of 500 ppm or less sulfur in order to meet the proposed emission standards in-use. For this reason, it is important that NRLM end users be able to know the sulfur level of the fuel they are purchasing and dispensing. Therefore, fuel pump dispensers for the various sulfur grades would also need to be properly labeled.

For pumps dispensing 500 ppm (maximum) sulfur content diesel fuel for nonroad equipment engines subject to pull-ahead standards, we propose that the label read as follows:

LOW-SULFUR NON-HIGHWAY DIESEL FUEL
(500 ppm Maximum)
WARNING
Not for Use In Highway Vehicles or Engines.

It is also likely that prior to June 1, 2010 some 15 ppm (maximum) diesel fuel will be introduced into the nonroad market early. Both the engine and fuel credit provisions envision such early introduction of 2011-compliant engines and 15 ppm fuel. Thus, it is important that nonroad end users be able to know when they are purchasing diesel fuel with 15 ppm or less sulfur. For pumps dispensing 15 ppm (maximum) sulfur content diesel fuel for nonroad equipment engines subject to pull-ahead standards, we propose that the label read as follows:

ULTRA-LOW SULFUR NON-HIGHWAY DIESEL FUEL
(15 ppm Maximum)
Required for All Model Year 2011 and Newer Nonroad Diesel Engines.
Recommended for Use in All Nonroad, Locomotive and Marine Diesel Engines.
WARNING
Not for Use in Highway Vehicles or Engines.

For all other nonroad equipment, locomotive, and marine engine diesel fuel pumps (that is, pumps dispensing diesel fuel having a sulfur content greater than 500 ppm) we propose that the label read as follows:

HIGH-SULFUR NON-HIGHWAY DIESEL FUEL
(May Exceed 500 ppm)
WARNING
Not for Use In Highway Vehicles or Engines.
Not for Use in Nonroad, Locomotive, or Marine Engines after August 31, 2010.
May Damage Engines Certified for Use on Low-Sulfur or Ultra-Low Sulfur Diesel Fuel.

During this time period, as discussed in section IV.B.2.b, it would be necessary to segregate heating oil from nonroad, locomotive and marine diesel fuel to avoid circumventing the intent of the first step of the proposed nonroad standards -- that PM and SO2 benefits be achieved by producing fuel to the NRLM diesel fuel standards in an amount that fully corresponds to the amount of fuel used in these engines. Consequently, for pumps dispensing non-highway diesel fuel for use other than in nonroad, locomotive or marine engines, such as for use in stationary diesel engines or as heating oil, we propose that the label read as follows:

HEATING OIL (May Exceed 500 ppm Sulfur)
WARNING
Federal Law *Prohibits* Use in Highway Vehicles or Engines, or in Nonroad, Locomotive, or Marine Engines.
May Damage Engines Certified for Use on Low-Sulfur or Ultra-Low Sulfur Diesel Fuel.

c. Pump Labeling Requirements for 2010-2014

Beginning September 1, 2010, with certain exceptions, all fuel introduced into any nonroad engine, regardless of year of manufacture, would be required to meet the 15 ppm standard. The exceptions are that segregated small refiner nonroad diesel fuel and credit nonroad diesel fuel would be allowed to meet the 500 ppm sulfur standard only for use in pre-model year 2011 engines. This limited use of 500 ppm fuel would continue through August 31, 2014,[322] after which all nonroad fuel would have to meet the 15 ppm standard. Fuel for use in locomotive and

[322] Production of 500 ppm fuel under the credit provisions would be allowed until June 1, 2012, but small refiner fuel subject to the 500 ppm standard could continue to be produced until June 1, 2014 and would be available to end users until September 1, 2014.

marine engines would be required to meet the 500 ppm standard without exception. As discussed in section IV.B.3.b, during this time period, it would be necessary to segregate the 500 ppm (maximum) locomotive and marine diesel fuel from the small refiner and credit 500 ppm (maximum) nonroad diesel fuel to ensure an adequate supply of ultra low-sulfur (15 ppm maximum) nonroad diesel fuel for nonroad purposes.

For pumps dispensing 15 ppm (maximum) sulfur content nonroad diesel fuel, we propose that the label read as follows:

ULTRA-LOW SULFUR NON-HIGHWAY DIESEL FUEL
(15 ppm Maximum)
Required for all Model Year 2011 and Newer Nonroad Diesel Engines.
Recommended for Use in All Nonroad, Locomotive and Marine Diesel Engines.
WARNING
Not for Use in Highway Vehicles or Engines.

For pumps dispensing segregated small refiner or credit 500 ppm (maximum) nonroad diesel fuel, as discussed in section IV.B.3.b, we propose that the label read as follows:

LOW-SULFUR NON-HIGHWAY DIESEL FUEL
(500 ppm Maximum)
WARNING
May Damage Model Year 2011 and Newer Nonroad Engines
Federal Law *Prohibits* Use in All Model Year 2011 and Newer Nonroad Engines.
Not for Use In Highway Vehicles or Engines.

For pumps dispensing marked 500 ppm sulfur (maximum) locomotive and marine diesel fuel, as discussed in section IV.B.3.b, we propose that the label read as follows:

LOW-SULFUR LOCOMOTIVE OR MARINE DIESEL FUEL
(500 ppm Maximum)
WARNING
Federal Law *Prohibits* Use in Other Nonroad Engines or in Highway Vehicles or Engines
May Damage Model Year 2007 and Newer Highway Diesel Engines and 2011 and Newer Nonroad Diesel Engines.

For pumps dispensing high-sulfur fuel for use as heating oil, we propose that the label read as follows:

HEATING OIL (May Exceed 500 ppm Sulfur)
WARNING
Federal Law *Prohibits* Use in Highway Vehicles or Engines, or in Nonroad, Locomotive, or Marine Engines.
May Damage Engines Certified for Use on Low-Sulfur or Ultra-Low Sulfur Diesel Fuel.

d. Pump Labeling Requirements for 2014 and Beyond

Beginning September 1, 2014, all nonroad fuel distributed to end-users would be required to meet the 15 ppm standard, without exception. Locomotive and marine fuel would continue to be subject to the 500 ppm standard, without exception. The pump labels for heating oil would continue to be the same as for the period 2010 through 2014.

For pumps dispensing nonroad diesel fuel, we propose that the label read as follows:

ULTRA-LOW SULFUR NON-HIGHWAY DIESEL FUEL
(15 ppm Maximum)
Required for all Nonroad Diesel Engines.
Recommended for Use in All Nonroad, Locomotive and Marine Diesel Engines.
WARNING
Not for Use in Highway Vehicles or Engines.

For pumps dispensing locomotive or marine diesel fuel, we propose that the label read as follows:

LOW-SULFUR LOCOMOTIVE OR MARINE DIESEL FUEL
(500 ppm maximum)
WARNING
Federal Law *Prohibits* Use in Other Nonroad Engines or in Highway Vehicles or Engines.
May Damage Model Year 2007 and Newer Highway Diesel Engines and 2011 and Newer Nonroad Diesel Engines.

For pumps dispensing high-sulfur fuel for use as heating oil, we propose that the label read the same as for that same fuel during the 2010-2014 time period, as follows:

HEATING OIL (May Exceed 500 ppm Sulfur)
WARNING
Federal Law *Prohibits* Use in Highway Vehicles or Engines, or in Nonroad, Locomotive, or Marine Engines.
May Damage Engines Certified for Use on Low-Sulfur or Ultra-Low Sulfur Diesel Fuel.

e. Nozzle Size Requirements or other Requirements to Prevent Misfueling

Like the highway diesel fuel program, the proposed NRLM diesel fuel program does not include a nozzle size requirement. In part this is because we are not aware of an effective and practicable scheme to prevent misfueling through the use of different nozzle sizes or shapes, and in part because we do not believe that improper fueling would be a significant enough problem to warrant such an action. In the preamble to the highway diesel fuel rule, we stated our belief that the use of unique nozzles, color-coded scuffguards, or dyes to distinguish the grades of diesel fuel may be useful in preventing accidental use of the wrong fuel. (See 66 FR 5119, January 18, 2001.) However, we did not finalize any such requirements, for the reasons described in the RIA for that final rule (Chapter IV.E.).

Similar reasoning applies to the proposed NRLM diesel fuel program. For example, 15 ppm diesel fuel would be the dominant fuel in the market by 2010, likely comprising more than 80 percent of all number 2 distillate. Furthermore, after 2010, we believe that 500 ppm diesel fuel would have limited availability until 2014. High-sulfur distillate for heating oil uses would remain, but will only exist in significant volumes in certain parts of the country. In any event, we believe that most owners and operators of new nonroad diesel engines and equipment would not risk voiding the general warranty and the emissions warranty by misfueling.

Although in the highway diesel fuel rule we did not finalize any provisions beyond fuel pump labeling requirements, we recognized that some potential for misfueling would still exist. Consequently, we expressed a desire to continue to explore with industry simple, cost-effective approaches that could further minimize misfueling potential such as color-coded nozzles/scuff guards. Since the highway diesel rule was promulgated, we have had discussions with fuel retailers, wholesale purchaser-consumers, vehicle manufacturers, and nozzle manufacturers and continue to examine different methods for preventing accidental or intentional misfueling under the highway diesel fuel sulfur program. To date, no consensus exists among the affected stakeholders, including engine and truck manufacturers, truck operators, fuel retailers, and fuel nozzle manufacturers. However, we will continue discussions with these and other stakeholders. We will consider any new developments that result from these highway discussions in a future nonroad action.

3. Use of Used Motor Oil in New Nonroad Diesel Equipment

We understand that used motor oil is sometimes blended with diesel fuel for use as fuel in nonroad diesel equipment. Such practices include blending used motor oil directly into the equipment fuel tank, blending it into the fuel storage tanks, and blending small amounts of motor oil from the engine crank case into the fuel system as the equipment is operated.

However, motor oil normally contains high levels of sulfur. Thus, the addition of used motor oil to nonroad diesel fuel could substantially impair the sulfur-sensitive emissions control equipment expected to be used by engine manufacturers to meet the emissions standards proposed in today's NPRM. Depending on how the oil is blended, it could increase the sulfur content of the fuel by as much as 200 ppm. As a result, we believe blending used motor oil into nonroad diesel fuel could render inoperative the expected emission control technology and potentially cause driveability problems. It should be prohibited as a violation of the tampering prohibition in the Act. See CAA Sections 203(a)(3), 213(d).

Therefore, like the highway diesel rule, this proposal would prohibit any person from introducing or causing or allowing the introduction of used motor oil, or diesel fuel containing used motor oil, into the fuel delivery systems of nonroad equipment engines manufactured in model year 2011 and later. The only exception to this would be where the engine was explicitly certified to the emission standard with used motor oil added and the oil was added in a manner consistent with the certification.

4. Use of Kerosene in Diesel Fuel

As we discussed in the highway diesel final rule, kerosene is commonly added to diesel fuel to reduce fuel viscosity in cold weather (see 66 FR 5120, January 18, 2001). This proposal would not limit this practice with regard to 500 ppm NRLM diesel fuel. However the resulting blend would still be subject to the 500 ppm sulfur standard. Consistent with the highway diesel fuel rule, kerosene that is used, intended for use, or made available for use as, or for blending with, 15 ppm sulfur nonroad diesel fuel would itself be required to meet the 15 ppm standard starting June 1, 2010 and must be itself classified as "nonroad diesel fuel" unless it was already classified as "motor vehicle diesel fuel." This classification as nonroad diesel fuel use could be made by the kerosene fuel's refiner or could be made by a downstream party at the point when that party chooses to use the kerosene in its possession for use as nonroad diesel fuel subject to the 15 ppm sulfur standard.

To help ensure that only distillates that comply with the proposed 15 ppm nonroad diesel fuel standard are blended into 15 ppm nonroad diesel fuel, this proposal would require that kerosene meeting the 15 ppm standard and distributed by the transferring party for use in nonroad equipment engines must be accompanied by PTDs accurately stating that the product meets the 15 ppm sulfur standard. (See Section VIII.E.7, below.)

As a general matter, any party who would blend kerosene, or any blendstock, into nonroad diesel fuel, or who would produce nonroad diesel fuel by mixing blendstocks, would be a refiner and would be subject to the requirements and prohibitions applicable to refiners under the proposed rule. However, under this proposal, in deference to the longstanding and widespread practice of blending kerosene into diesel fuel at downstream locations, downstream parties who only blend kerosene into nonroad diesel fuel will not be subject to the requirements applicable to other refiners, provided that they do not alter the fuel in any other way. This activity is treated the same way under the final highway diesel rule.

In order to ensure the continued compliance of 15 ppm fuel with the 15 ppm standard, downstream parties choosing to blend kerosene into 15 ppm nonroad diesel fuel would be required to either have a PTD for that kerosene indicating compliance with the 15 ppm standard, or to have test results for the kerosene establishing such compliance. Further, downstream parties choosing to blend kerosene into 15 ppm nonroad diesel fuel would be entitled to the 2 ppm adjustment factor discussed above for both the kerosene and the diesel fuel into which it is blended at downstream locations, provided that the kerosene had been transferred to the party with a PTD indicating compliance with that standard. Sulfur test results from downstream locations of parties who do not have such a PTD for their kerosene will not be subject to this adjustment factor, either for the kerosene itself, or for the nonroad diesel fuel into which it is blended.

Any party who causes the sulfur content of nonroad diesel fuel subject to the 15 ppm sulfur standard to exceed 15 ppm by blending kerosene into nonroad diesel fuel, or by using high sulfur kerosene as nonroad diesel fuel, would be subject to liability for violating the sulfur standard. Similarly, parties who cause the sulfur level of nonroad diesel fuel subject to the 500 ppm nonroad diesel fuel to exceed that standard by blending kerosene into the fuel, would also be subject to liability.

The proposed rule would not require refiners or importers of kerosene to produce or import kerosene meeting the 15 ppm sulfur standard. However, we believe that refiners will produce low sulfur kerosene in the same refinery processes that they use to produce low sulfur diesel fuel, and that the market will drive supply of low sulfur kerosene for those areas where, and during those seasons when, the product is needed for blending with nonroad, as well a highway, diesel fuel. We request comments regarding this proposed provision.

5. Use of Diesel Fuel Additives

Diesel fuel additives include lubricity improvers, corrosion inhibitors, cold-operability improvers, and static dissipaters. Use of such additives is distinguished from the use of kerosene by the low concentrations at which they are used and their relatively more complex chemistry.[323] The suitability of diesel fuel additives for use in diesel fuel meeting a 500 ppm sulfur specification has been well established due to the existence of 500 ppm highway diesel fuel in the marketplace since 1993. The suitability of additives for use in 15 ppm diesel fuel was addressed in the highway diesel program, which requires highway diesel fuel to meet a 15 ppm sulfur standard beginning in 2006. Our review of data submitted by additive and fuel manufacturers to comply with EPA’s Fuel and Fuel Additive Registration requirements indicates that additives to meet every purpose, including static dissipation, are currently in common use which meet a 15 ppm cap on sulfur content.[324] Since such low-sulfur additives are currently in use side-by-side with high-sulfur additives, it is reasonable to conclude that there is not a significant difference in their cost. The ability of industry to provide low-sulfur additives is supported by the fact that diesel fuel meeting a 10 ppm cap on sulfur content has been marketed in Sweden for some time and is beginning to be marketed in other countries such as Germany. Fifteen ppm diesel fuel is also being made available to a number of centrally fueled fleets across the U.S.

Even if not yet available for certain purposes, we believe that it is reasonable to assume that low-sulfur additives will become available before the 15 ppm sulfur standard for highway diesel fuel becomes effective in 2006. This will be well in advance of the proposed 2010 implementation date for a 15 pm sulfur standard on nonroad diesel fuel.

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[323] Diesel fuel additives are used at concentrations commonly expressed in parts per million. Diesel fuel additives can include specially-formulated polymers and other complex chemical components. Kerosene is used at much higher concentrations, expressed in volume percent. Unlike diesel fuel additives, kerosene is a narrow distillation fraction of the range of hydrocarbons normally contained in diesel fuel.

[324] See Chapter IV.D. of the RIA for the highway diesel fuel rule for more information on diesel fuel additives, EPA Air docket A-99-06, docket item V-B-01. Also See 40 CFR part 79.

As discussed in Section V of today's preamble, we expect that reducing the sulfur content of NRLM diesel fuel to the meet the proposed sulfur standards would not have a disproportionate impact on fuel lubricity compared to the reduction in lubricity associated with desulfurizing highway diesel fuel. We have no reason to expect that this situation would be any different with respect to the potential impact on nonroad diesel fuel properties other than fuel lubricity which might require the use of additives such as cold flow, and susceptibility to static build up. Consequently, our estimate of the increase in additive use that would result from the adoption of the proposed rule parallels that under the highway program. We estimate that the use of lubricity additives would increase, and that the use of other additives would be unaffected.[325] We request comment on this assessment.

Similar to the highway diesel rule, this proposed rule would allow the use of diesel fuel additives with a sulfur content greater than 15 ppm in nonroad diesel fuel. However, nonroad diesel fuel containing such additives would remain subject to the proposed 15 ppm sulfur cap. We believe that it is most appropriate for the market to determine how best to accommodate increases in the fuel sulfur content from the refinery gate to the end user, while maintaining the 15 ppm cap, and whether such increases result from contamination in the distribution system or diesel additive use. By providing this flexibility, we anticipate that market forces will encourage an optimal balance between the competing demands of manufacturing fuel lower than the15 ppm sulfur cap, limiting contamination in the distribution system, and limiting the additive contribution to fuel sulfur content.

As in the highway diesel program, additive manufacturers that market additives with a sulfur content higher than 15 ppm and blenders that use them in nonroad diesel fuel subject to the proposed 15 ppm sulfur standard would have additional requirements to ensure that the 15 ppm sulfur cap is not exceeded. The 15 ppm sulfur cap on highway diesel fuel that becomes effective in 2006 may encourage the gradual retirement of additives that do not meet a 15 ppm sulfur cap. The proposed 15 ppm sulfur cap for nonroad diesel fuel in 2010 may further this trend. However, we do not anticipate that this will result in disruption to additive users and producers or a significant increase in cost. Additive manufacturers commonly reformulate their additives on a periodic basis as a result of competitive pressures. We anticipate that any reformulation that might need to occur to meet a 15 ppm sulfur cap will be accomplished prior to the implementation of the 15 ppm sulfur cap on highway diesel fuel in 2006.

Like the highway diesel fuel rule, this proposed rule would limit the continued use in nonroad diesel fuel that is subject to the proposed 15 ppm sulfur standard of additives that exceed 15 ppm sulfur. These additives would be limited to use in concentrations of less than one volume percent. We believe that this limitation is appropriate and would not cause any undue burden because the diesel fuel additives for which this flexibility was included are always used today at concentrations well below one volume percent. Further, one volume percent is the threshold above which the blender of an additive becomes subject to all the requirements applicable to a refiner. See 40 CFR 79.2(d)(1).

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[325] See Section IV.G. of today's preamble for a discussion of the potential impact of the proposed sulfur standards on fuel lubricity.

The specific proposed requirements regarding the use of diesel fuel additives in nonroad diesel fuel subject to the proposed 15 ppm standard are as follows:

- Additives that have a sulfur content at or below 15 ppm must be accompanied by a PTD that states: "The sulfur content of this additive does not exceed 15 ppm."

- Additives that exceed 15 ppm sulfur could continue to be used in nonroad diesel fuel subject to the proposed 15 ppm sulfur standard provided that they are used at a concentration of less than one volume percent and their transfer is accompanied by a PTD that lists the following:
    1) a warning that the additive's sulfur content may exceed 15 ppm
    2) the additive's maximum sulfur concentration
    3) the maximum recommended concentration for use of the additive in diesel fuel, and
    4) the contribution to the sulfur level of the fuel that would result if the additive is used at the maximum recommended concentration.

Blenders of additives that exceed 15 ppm in sulfur content would be liable if their actions caused the sulfur content of the finished nonroad diesel fuel to exceed 15 ppm. In some cases, blenders may not find it feasible to conduct testing, or otherwise obtain information on the sulfur content of the fuel either before or after additive blending, without incurring substantial cost. We anticipate that blenders would manage the risk associated with the use of additives above 15 ppm in sulfur content under such circumstances with actions such as the following:

- selecting an additive with minimal sulfur content above 15 ppm that is used at a low concentration, and
- working with their upstream suppliers to provide fuel of sufficiently low sulfur content to accommodate the small increase in sulfur content which results from the use of the additive.

This is similar to the way distributors would manage contamination from their distribution hardware, such as tank trucks. Distributors would not necessarily test for fuel sulfur content after each opportunity for contamination, but rather will rely on mechanisms set up to minimize the contamination, and to obtain fuel sufficiently below the standard to accommodate the increase in sulfur content from the contamination.

The recordkeeping, reporting, and PTD provisions associated with these proposed requirements are discussed in Section VIII.E below. The liability provisions are discussed in Section VIII.F below.

The 1993 and 2007 highway diesel programs did not contain any requirements regarding the maximum sulfur content of additives used in highway diesel fuel subject to a 500 ppm sulfur cap.[326] Our experience under the highway program indicates that application of the 500 ppm sulfur cap throughout the distribution system to the end-user has been sufficient to prevent the use of additives from jeopardizing compliance with the 500 ppm sulfur standard. The potential increase of several ppm in the sulfur content of diesel fuel which might result from the use of diesel additives raises substantial concerns regarding the impact on compliance with a 15 ppm sulfur cap. However, this is not the case with respect to the potential impact on compliance with a 500 ppm sulfur cap. The current average sulfur content of highway diesel fuel of 340 ppm provides ample margin for the minimal increase in the fuel sulfur content which might result from the use of additives. We expect that this would also be the case for NRLM fuel subject to the proposed 500 ppm sulfur standard. Therefore, we are not proposing any requirements regarding the sulfur content of additives used in NRLM fuel subject to the proposed 500 ppm sulfur standard. We believe that the proposed requirement that NRLM fuel comply with the 500 ppm sulfur cap throughout the distribution system to the end-user would be sufficient to ensure that entities who introduce additives into such fuel take into account the potential increase in fuel sulfur content.

6. End User Requirements

In light of the importance of ensuring that the proper fuel is used in nonroad, locomotive, and marine engines covered by the proposed program, we propose to prohibit any person from fueling such an engine with fuel not meeting the applicable sulfur standard.

We propose that 1) no person may introduce, or permit the introduction of, fuel that exceeds 15 ppm sulfur content into nonroad equipment with a model year 2011 or later engine; 2) beginning December 1, 2010, no person may introduce, or permit the introduction of locomotive or marine fuel into any nonroad diesel engine; 3) beginning December 1, 2010, no person may introduce, or permit the introduction of any fuel exceeding 15 ppm sulfur content into any nonroad diesel engine regardless of year of manufacture, except that segregated 500 ppm nonroad diesel fuel produced by qualified small refiners, hardship refiners, or refiners using credits may be introduced into pre-2011 model year nonroad diesel engines; 4) beginning December 1, 2010, no person may introduce, or permit the introduction of fuel exceeding 500 ppm sulfur content into any locomotive or marine diesel engine; and 5) beginning December 1, 2014, no person may introduce, or permit the introduction of, fuel exceeding 15 ppm sulfur content into any nonroad diesel engine.

7. Anti-Downgrading Provisions

[326] The 500 ppm highway diesel final rule contains the requirement that highway diesel fuel not exceed 500 ppm in sulfur content at any point in the fuel distribution system including after the blending of additives. Fuel Quality Regulations for Highway Diesel Fuel Sold in 1993 and Later Calendar Years, Final Rule, 55 FR 34120, August 21, 1990.

The highway diesel rule restricts downgrading of 15 ppm highway diesel fuel to 500 ppm highway diesel fuel, from June 1, 2006 - May 31, 2010 by preventing downstream entities from intentionally downgrading 15 ppm highway fuel. This is to protect the nationwide availability of 15 ppm highway fuel. The concern was that since both 15 ppm highway fuel and 500 ppm highway fuel were expected to be comparably priced, entities downstream of the refinery could simply take delivery of whichever fuel was cheapest and commingle the two fuel grades into a single pool of 500 ppm highway fuel. We chose not to restrict downgrading to non-highway fuel grades, however, for three reasons. First, in order to avoid reprocessing costs, an outlet was needed for legitimately downgraded fuel produced through contamination in the distribution system. Second, the price differential between 15 ppm fuel and high sulfur non-highway fuel was expected to be sufficient to deter any intentional downgrading. Third, many of the entities such as retailers and fleets that might have an incentive to downgrade 15 ppm highway fuel do not market non-highway fuel, and therefore would have no opportunity to do so.

With this proposal, however, all NRLM diesel fuel would also be required to meet the 500 ppm sulfur standard beginning June 1, 2007 and it could be mixed fungibly with 500 ppm sulfur highway fuel up to the point where dye was added for IRS excise tax purposes. As a result, application of the current anti-downgrading provision in the highway diesel rule is ambiguous with respect to what would and would not be allowed under this proposal. Furthermore, the assumption in the highway rule that the price differential between 15 ppm highway and non-highway fuel would be sufficient to deter intentional downgrading would not necessarily be valid any longer, given the application of the 500 ppm sulfur standard to NRLM diesel fuel. For these reasons, we propose that the anti-downgrading provisions contained in 40 CFR 80.527 be modified to restrict downgrading of undyed 15 ppm diesel fuel to any 500 ppm diesel fuel, whether the 500 ppm sulfur fuel is intended for highway purposes or NRLM purposes. We would continue to allow unrestricted downgrading of undyed 15 ppm diesel fuel to fuel which is marked as heating oil.

We further propose that the downgrading restriction apply to any undyed 15 ppm diesel fuel produced. Since the two fuels would be distributed together, this modification to the downgrading limitations would be needed to enable enforcement of the highway diesel fuel downgrading limitations. We are not proposing any extension of that the anti-downgrading provisions beyond their current set date of June 1, 2010. The purpose of the anti-downgrading provisions is to ensure availability of 15 ppm highway fuel nationwide, and we do not anticipate this as a concern after June 1, 2010. This proposal allows early credit for 15 ppm NRLM diesel fuel produced beginning June 1, 2009. Although availability is not an issue for this fuel, it will be fungible with highway fuel subject to the 15 ppm sulfur standard. Consequently, we seek comment on whether the anti-downgrading provision could expire then as well without negatively impacting the availability of 15 ppm diesel fuel for highway vehicles. We request comment on these proposed revisions of the anti-downgrading provisions.[327]

[327] Since the time of the highway diesel final rule, we have become aware of the need for several other clarifications of the anti-downgrading provisions. We intend to address these general issues through a future amendment to the highway diesel rule.

While these proposed downgrading provisions apply primarily to parties in the distribution system downstream of the refiners and importers, these requirements would also apply to refiners and importers.

D. Diesel Fuel Sulfur Sampling and Testing Requirements

1. Testing Requirements

As part of today's action, we are proposing a new approach for fuel sulfur measurement. The details of this approach are described below, followed by a description of who would be required to conduct fuel sulfur testing as well as what fuel they would be required to test.

a. Test Method Approval, Recordkeeping, and Quality Control Requirements

Most current and past EPA fuel programs designated specific analytical methods which refiners, importers, and downstream parties use to analyze fuel samples at all points in the fuel distribution system for regulatory compliance purposes. Some of these programs have also allowed certain specific alternative methods which may be used as long as the test results are correlated to the designated test method. The highway diesel rule (66 FR 5002, January 18, 2001), for example, specifies one designated test method and three alternative methods for measuring the sulfur content of highway diesel fuel subject to the 15 ppm sulfur standard. The rule also specifies one designated method and three alternative methods for measuring the sulfur content of highway diesel fuel subject to the 500 ppm sulfur standard.

The highway diesel fuel sulfur rule also announced the Agency's intention to adopt a performance-based test method approach in the future, as well as our intention to continue working with the industry to develop and improve sulfur test methods. Under today's action, we are proposing to adopt a performance-based test method approach for diesel fuel subject to the 15 ppm sulfur standard. We are also proposing to adopt such an approach as an option for diesel fuel subject to the 500 ppm sulfur standard. The current approach for measuring the sulfur content of diesel fuel subject to the 500 ppm sulfur standard, i.e., using the designated sulfur test method or one of the alternative test methods with correlation could continue to be used.

TABLE IV-D-1 DESIGNATED AND ALTERNATIVE SULFUR TEST METHODS ALLOWED UNDER THE HIGHWAY DIESEL PROGRAM

Sulfur Test Method	500 ppm	15 ppm
ASTM D 2622-98 as modified, *Standard Test Method for Sulfur in Petroleum Products by X-Ray Spectrometry*	Designated	Alternative
ASTM D 3120-96, *Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry*		Alternative
ASTM D 4294, *Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-ray Fluorescence Spectrometry*	Alternative	
ASTM D 5453-00, *Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence*	Alternative	Alternative
ASTM D 6428-99, *Test Method for Total Sulfur in Liquid Aromatic Hydrocarbons and Their Derivatives by Oxidative Combustion and Electrochemical Detection.*	Alternative	Designated

Under the performance-based approach, a given test method would be approved for use in a specific laboratory by meeting certain precision and accuracy criteria specified in the regulations. The method would be approved for use by that laboratory as long as appropriate quality control procedures were followed. Properly selected precision and accuracy values potentially would allow multiple methods and multiple commercially available instruments to be approved, thus providing greater flexibility in method and instrument selection while also encouraging the development and use of better methods and instrumentation in the future. Under this approach, there would be no designated sulfur test method as specified under previous regulations.

Since any test method that meets the specified performance criteria may qualify, this type of approach does not conflict with the "National Technology Transfer and Advancement Act of 1995" (NTTAA), section 12(d) of Public Law 104-113, and the Office of Management and Budget (OMB) Circular A -119. Both of these documents are designed to encourage the adoption of standards developed by "voluntary consensus bodies" and to reduce reliance on government-unique standards where such consensus standards would suffice. Under the performance criteria approach proposed today, methods developed by consensus bodies as well as methods not yet approved by a consensus body would qualify for approval provided they met the specified performance criteria as well as the recordkeeping and reporting requirements for quality control purposes.

i. How Can a Given Method be Approved?

Under the proposed performance criteria approach, a given test method would be approved for use under today's program by meeting certain precision and accuracy criteria. Approval would apply on a laboratory/facility-specific basis. If a company chose to employ more than one laboratory for fuel sulfur testing purposes, then each laboratory would have to separately seek approval for each method it intends to use. Likewise, if a laboratory chose to use more than one sulfur test method, then each method would have to be approved separately. Separate approval would not be necessary for individual operators or laboratory instruments within a given laboratory facility.

The specific precision and accuracy criteria that we are proposing were derived from existing sulfur test methods that are either required or allowed under the highway diesel fuel sulfur program. The first criterion, precision, refers to the consistency of a set of measurements and is used to determine how closely analytical results can be duplicated based on repeat measurements of the same material under prescribed conditions. To demonstrate the precision of a given sulfur test method under the performance-based approach, a laboratory facility would perform 20 repeat tests over 20 days on samples taken from a homogeneous supply of a commercially available diesel fuel. We request comment on an alternative number of days over which these 20 repeat tests should be conducted. Using the test results[328] of ASTM D 3120 for diesel fuel subject to the 15 ppm sulfur standard, the precision would have to be less than 0.72 ppm.[329] Similarly, using the test results of ASTM D 2622 for diesel fuel subject to the 500 ppm sulfur standard, the precision would have to be less than 9.68 ppm.

The second criterion, accuracy, refers to the closeness of agreement between a measured or calculated value and the actual or specified value. To demonstrate the accuracy of a given test method under the performance-based approach, a laboratory facility would be required to perform 10 repeat tests on a standard sample, the mean of which for diesel fuel subject to the 15 ppm sulfur standard could not deviate from the Accepted Reference Value (ARV) of the standard by more than 0.54 ppm and for diesel fuel subject to the 500 ppm sulfur standard could not deviate from the ARV of the standard by more than 7.26 ppm[330]. These tests would be performed using commercially available gravimetric sulfur standards. Ten tests would be required using each of two different sulfur standards–one in the range of 1-10 ppm sulfur and the other in the range of

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[328] Sulfur Repeatability of Diesel by Method at 15 ppm, ASTM Report on Low Level Sulfur Determination in Gasoline and Diesel Interlaboratory Study - A Status Report, June 2002.

[329] 0.72 ppm is equal to 1.5 times the standard deviation of ASTM D 3120, where the standard deviation is equal to the repeatability of ASTM D 3120 (1.33) divided by 2.77. 9.68 ppm is equal to 1.5 times the standard deviation of ASTM D 2622, where the standard deviation is equal to the repeatability of ASTM D 2622 (26.81) divided by 2.77. Since the conditions of the precision qualification test admit more sources of variability than the conditions under which ASTM repeatability is determined (longer time span, different operators, environmental conditions, etc.) the repeatability standard deviation derived from the round robin was multiplied by what we believe to be a reasonable adjustment factor, 1.5, to compensate for the difference in conditions.

[330] 0.54 and 7.26 are equal to 0.75 times the precision values of 0.72 for 15 ppm sulfur diesel and 9.68 for 500 ppm sulfur diesel, respectively.

10-20 ppm sulfur for 15 ppm fuel and one in the range of 100-200 ppm sulfur and the other in the range of 400-500 ppm sulfur for 500 ppm sulfur diesel fuel. Therefore, a minimum of 20 total tests would be required for sufficient demonstration of accuracy for a given sulfur test method at a given laboratory facility. Finally, any known interferences for a given test method would have to be mitigated.

These requirements are not intended be overly burdensome. Indeed, we believe these requirements are equivalent to what a laboratory would do during the normal start up procedure for a given test method. In addition, we believe this approach would allow regulated entities to know that they are measuring diesel fuel sulfur levels accurately and within reasonable site reproducibility limits. Nevertheless, we request comment on this performance criteria approach and the specific precision and accuracy criteria we are proposing.

ii. What Information Would Have To Be Reported to the Agency?

For test methods that have already been approved by a voluntary consensus standards body[331] (VCSB), such as ASTM or the International Standards Organization (ISO), each laboratory facility would be required to report to the Agency the precision and accuracy results as described above for each method for which it is seeking approval. Such submissions to EPA, as described elsewhere, would be subject to the Agency's review for 90 days, and the method would be considered approved in the absence of EPA comment. Laboratory facilities would be required to retain the fuel samples used for precision and accuracy demonstration for 30 days. We seek comment on an alternative number of days for which such fuel samples should be retained.

For test methods that have not been approved by a VCSB, full test method documentation, including a description of the technology/instrumentation that makes the method functional, as well as subsequent EPA approval of the method would also be required. These submissions would also be subject to the Agency's review for 90 days, and the method would be considered approved in the absence of EPA comment. Submission of VCSB methods would not be required since they are available in the public domain. In addition, industry and the Agency have likely had substantial experience with such methods. The approval of non-VCSB methods would be valid for five years. After this time period, the approval would be rescinded unless the method had been adopted by a consensus body. If, a consensus body does not ultimately approve the method then the method could no longer be used as an approved method.

As described above, federal government and EPA policy is to use standards developed by voluntary consensus bodies when available. The purpose of the NTTAA, at least in part, is to foster consistency in regulatory requirements, to take advantage of the collective industry wisdom and wide-spread technical evaluation required before a test method is approved by a consensus body, and to take advantage of the ongoing oversight and evaluation of a test method by the consensus body that results from wide-spread use of an approved method e.g., the ongoing round-robin type analysis and typical annual updating of the method by the consensus body. These goals

[331] These are standard-setting organizations, like ASTM, and ISO that have broad representation of all interested stakeholders and make decisions by consensus.

are not met where the Agency allows use of a non-consensus body test method in perpetuity. Moreover, it is not possible to realize many of the advantages that result from consensus status where a test method is used by only one or a few companies. It will not have the practical scrutiny that comes from ongoing wide-spread use, or the independent scrutiny of the consensus body and periodic updating. In addition, EPA does not have the resources to conduct the degree of initial scrutiny or ongoing scrutiny that are practiced by consensus bodies. Nevertheless, EPA believes it is appropriate to allow limited use of a proprietary test method for a limited time, even though the significant advantages of consensus test methods are absent, because EPA can evaluate the initial quality of a method and a company may have invested significant resources in developing a method. However, if after a reasonable time a test method fails to gain consensus body approval, EPA believes approval of the method should be withdrawn because of the absence of ongoing consensus oversight. Accordingly, we propose that a non-VCSB method will cease to be qualified five years from the date of its original approval by EPA in the absence of VCSB approval.

To assist the Agency in determining the performance of a given sulfur test method, non-VCSB methods, in particular, we propose to reserve the right to send samples of commercially available fuel to laboratories for evaluation. Such samples would be intended for situations in which the Agency had concerns regarding a test method and, in particular, its ability to measure the sulfur content of a random commercially available diesel fuel. Laboratory facilities would be required to report their results from three tests of this material to the Agency.

iii. What Quality Control Provisions Would Be Required?

We are proposing to require ongoing Quality Control (QC) procedures for sulfur measurement instrumentation. These are procedures used by laboratory facilities to ensure that the test methods they have qualified and the instruments on which the methods are run are yielding results with appropriate accuracy and precision, e.g., that the results from a particular instrument do not "drift" over time to yield unacceptable values. It is our understanding that most laboratories already employ QC procedures, and that these are commonly viewed as important good laboratory practices. Under the performance- based approach, laboratories would be required, at a minimum, to abide by the following QC procedures for each instrument used to certify batches of diesel fuel under these regulations:

1) Follow the mandatory provisions of ASTM D 6299-02, *Standard Practice for Applying Statistical Quality Assurance Techniques to Evaluate Analytical Measurement System Performance*. Laboratories would be required to construct control charts from the mandatory QC sample testing prescribed in paragraph 7.1, following the guidelines under A 1.5.1 for individual observation charts and A 1.5.2 for moving range charts.

2) Follow ASTM D6299-02 paragraph 7.3.1 (check standards) using a standard reference material. Check standard testing would be required to occur at least monthly and should take place following any major change to the laboratory equipment or test procedure. Any deviation from the accepted reference value of

the check standard greater than 1.44 ppm for diesel fuel subject to the 15 ppm sulfur standard and 19.36 ppm for diesel fuel subject to the 500 ppm sulfur standard[332] would have to be investigated.

3) Upon discovery of any QC testing violation of A 1.5.2.1 or A 1.5.3.2 or check standard deviation greater than 1.44 ppm and 19.36 ppm for 15 ppm sulfur diesel and 500 ppm sulfur diesel, respectively, as provided in item 2 above, any measurement made while the system was out of control would be required to be tagged as suspect and an investigation conducted into the reasons for this anomalous performance. We also propose that refiners and importers would be required to retain batch samples for a limited amount of time. For example, a retain period could be equal to the interval between QC sample tests. If an instrument was found to be out of control, we propose that all of the retained samples since the last time the instrument was shown to be in control would have to be retested. We seek comment on alternative ways to handle situations in which a method goes out of control at some unknown point in time between check standard tests or between QC sample tests.

4) QC records, including investigations under item 3 above would be required to be retained for five years and to be provided to the Agency upon request.

b. Requirements to Conduct Fuel Sulfur Testing.

Given the importance of assuring that nonroad diesel fuel designated to meet the 15 ppm sulfur standard in fact meets that standard, we are proposing that refiners and importers must test each batch of nonroad diesel fuel designated to meet the 15 ppm sulfur standard and to maintain records of such testing. Requiring that refiners and importers test each batch of fuel subject to the 15 ppm nonroad standard would assure that compliance could be confirmed through testing records, and even more importantly, would assure that nonroad diesel fuel exceeding the 15 ppm standard was not introduced into commerce as fuel for use in nonroad equipment having sulfur-sensitive emission control devices. Batch testing is currently not required under the highway diesel rule, and instead such testing is typically performed to establish a defense to potential liability. However, for the same reasons discussed above, we propose to extend this batch testing requirement to 15 ppm sulfur highway diesel fuel beginning in 2006.

We are not proposing to require downstream parties to conduct every-batch testing. However, we believe most downstream parties would voluntarily conduct "periodic" sampling and testing for quality assurance purposes if they wanted to establish a defense to presumptive liability, as discussed in VIII.G below.

[332] 1.44 ppm is equal to two times the proposed precision of 0.72 ppm for 15 ppm diesel and 19.36 is equal to two times the proposed precision of 9.68 ppm for 500 ppm diesel.

2. Two Part-Per-Million Downstream Sulfur Measurement Adjustment

We believe that it would be appropriate to recognize sulfur test variability in determining compliance with the proposed nonroad diesel fuel sulfur standard downstream of a refinery or import facility. Thus, we propose that for all 15 ppm sulfur nonroad diesel fuel at locations downstream of the refinery or import facility, sulfur test results could be adjusted by subtracting two ppm. The sole purpose of this downstream compliance provision is to address test variability concerns. We anticipate that the reproducibility of sulfur test methods is likely to improve to two ppm or even less by the time the 15 ppm sulfur standard for highway diesel fuel is implemented -- four years before implementation date of the proposed 15 ppm standard for nonroad diesel fuel. With this provision, we anticipate that refiners would be able to produce diesel fuel with an average sulfur level of approximately 7-8 ppm and some contamination could occur throughout the distribution system, without fear of causing a downstream violation due solely to test variability. As test methods improve in the future, we propose to reevaluate whether two ppm is the appropriate allowance for purposes of this compliance provision.

3. Sampling Requirements

This proposed rule would adopt the same sampling methods adopted by the highway diesel rule (66 FR 5002, January 18, 2001). The requirement to use these methods would be effective for nonroad diesel fuel June 1, 2007. These same methods were also adopted for use in the Tier 2/Gasoline Sulfur rule.[333] These sampling methods are American Society for Testing and Materials (ASTM) D 4057-95 (manual sampling) and D 4177-95 (automatic sampling from pipelines/in-line blending).

4. Alternative Sampling and Testing Requirements for Importers of Diesel Fuel Who Transport Diesel Fuel by Tanker Truck

We understand that importers who transport diesel fuel into the U.S. by tanker truck are frequently relatively small businesses that could be subject to a substantial burden if they were required to sample and test each batch of nonroad or highway diesel fuel imported by truck, especially where a trucker imports many small loads of diesel fuel. Therefore, we are proposing that truck importers could comply with an alternative sampling and testing requirement, involving a sampling and testing program of the foreign truck loading terminal, if certain conditions were met. For an importer to be eligible for the alternative sampling and testing requirement, the terminal would have to conduct sampling and testing of the nonroad or highway diesel fuel immediately after each receipt into its terminal storage tank or immediately before loading product into the importer's tanker truck storage compartments. Moreover, the importer would be

[333] 65 FR 6833-34 (Feb. 10, 2000). These methods are also proposed for use under the RFG and CG rules. See 62 FR 37337 *et seq*. (July 11, 1997).

required to allow EPA to conduct periodic quality assurance testing of the terminal's diesel fuel, and the importer would be required to assure that EPA would be allowed to make unannounced inspections and audits, to sample and test fuel at the foreign terminal facility, to assure that the terminal maintained sampling and testing records, and to submit such records to EPA upon request. We request comment on this proposal.

E. Fuel Marker Test Method

As discussed in Section IV.B.2.a.i above, we propose the use of solvent yellow 124 to differentiate diesel fuel intended for different uses. This marker is currently use in Europe. However, there is currently no test procedure recognized by the European Union to quantify the presence of the solvent yellow 124 in distillate fuels. The most commonly accepted method used in the European Union is based on the chemical extraction of the Euromarker using hydrocloric acid solution and cycloxane, and the subsequent evaluation of the extract using a visual spectrometer to determine the concentration of the marker.[334] This test is inexpensive and easy to use for field inspections. However, the test involves reagents that require some safety precautions and the small amount of fuel required in the test must be disposed of as hazardous waste. Nevertheless, we believe that such safety concerns are manageable here in the U.S. just as they are in Europe and that the small amount of waste generated can be handled along with other similar waste generated by the company conducting the test, and that the associated effort/costs would be negligible.

Similar to the approach proposed regarding the measurement of fuel sulfur content discussed in Section VIII.D. above, we are proposing a performance-based procedure to measure the concentration of solvent yellow 124 in distillate fuel. Section VIII.D above describes our rationale for proposing performance-based test procedures. Under the performance-based approach, a given test method could be approved for use in a specific laboratory or for field testing by meeting certain precision and accuracy criteria. Properly selected precision and accuracy values potentially would allow multiple methods and multiple commercially available instruments to be approved, thus providing greater flexibility in method and instrument selection while also encouraging the development and use of better methods and instrumentation in the future. For example, we are hopeful that with more time and effort a simpler test can be developed that can avoid the use of reagents and the generation of hazardous waste that is by product of the current commonly accepted method.

Under the performance criteria approach proposed today, methods developed by consensus bodies as well as methods not yet approved by a consensus body would qualify for approval provided they met the specified performance criteria as well as the recordkeeping and reporting requirements for quality control purposes. There would be no designated marker test method. We request comment on whether it would be more appropriate to adopt a designated marker test

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[334] Memorandum to the docket entitled "Use of a Visible Spectrometer Based Test Method in Detecting the Presence and Determining the Concentration of Solvent Yellow 124 in Diesel Fuel."

method. Such comments would be most useful if they include complete details on a suitable designated marker test method.

1. How Could a Given Marker Test Method be Approved?

Under the proposed performance criteria approach, a given marker test method would be approved for use under today's program by meeting certain precision and accuracy criteria. Approval would apply on a laboratory/facility-specific basis. If a company chose to employ more than one laboratory for fuel marker testing purposes, then each laboratory would have to separately seek approval for each method it intends to use. Likewise, if a laboratory chose to use more than one marker test method, then each method would have to be approved separately. Separate approval would not be necessary for individual operators or laboratory instruments within a given laboratory facility. The method would be approved for use by that laboratory as long as appropriate quality control procedures were followed.

In developing the precision and accuracy criteria for the sulfur test method, EPA drew upon the results of an interlaboratory study conducted by the American Society for Testing and Materials (ASTM) to support ASTM's standardization of the sulfur test method. Unfortunately, there has not been sufficient time for industry to standardize the test procedure used to measure the concentration of solvent yellow 124 in distillate fuels or to conduct an interlaboratory study regarding the variability of the method. Nevertheless, the European Union has been successful in implementing its marker requirement while relying on the marker test procedures which are currently available, as noted above. We are proposing to use this procedure to establish the precision and accuracy criteria on which a marker test procedure would be approved under the performance-based approach. We request comment on the suitability of the proposed reference marker test method ,including whether standardized acceptability criteria exist regarding the visible spectrometer apparatus and associated measurement procedure used in performing the test.

There has been substantial experience in the use of the proposed reference market test method since the August 2002 effective date of the European Union's marker requirement. However, EPA is aware of only limited summary data on the variability of the reference test method from a manufacturer of the visible spectrometer apparatus used in the testing.[335]   The stated resolution of the test method from in the materials provided by this equipment manufacturer is 0.1 mg/L, with a repeatability of plus or minus 0.08 mg/L and a reproducibility of plus or minus 0.2 mg/L.[336]   In the lack of more extensive data, we propose to use these available

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[335] Technical Data on Fuel/Dye/Marker & Color Analyzers, as downloaded from the Petroleum Analyzer Company L.P. website at http://www.petroleum-analyzer.com/product/PetroSpec/lit_pspec/DTcolor.pdf.

[336] Repeatability and reproducibility are terms related to test variability. ASTM defines repeatability as the difference between successive results obtained by the same operator with the same apparatus under constant operating conditions on identical test materials that would, in the long run, in the normal and correct operation of the test method be exceeded only in one case in 20. Reproducibility is defined by ASTM as the difference between two single and independent results obtained by different operators working in different laboratories on identical material that would, in the long run, be exceeded only in one case in twenty.

data as the basis of our proposed precision and accuracy criteria as discussed below. We request that comments which suggest that these data are unsuitable for the intended use also include additional test data where possible to improve the derivation of precision and accuracy criteria.

Using a similar methodology to that employed in deriving the proposed sulfur test procedure precision value results in a precision value for the marker test procedure of 0.043 mg/L.[337] However, we are concerned that the use of this precision value, because it is based on very limited data, might preclude the acceptability of test procedures that would be adequate for the intended regulatory use. In addition, the lowest measurement of marker concentration that would have relevance under the regulations is 0.1 mg per liter. Consequently, we are proposing that the precision of a marker test procedure would need to be less than 0.1 mg/L for it to qualify. We request comment on this proposed precision level.

We are proposing that to demonstrate the accuracy of a given test method, a laboratory facility would be required to perform 10 repeat tests, the mean of which could not deviate from the Accepted Reference Value (ARV) of the standard by more than 0.05 mg/L. We believe that the proposed accuracy level is not overly restrictive, while being sufficiently protective considering that the lowest marker level of regulatory significance would be 0.1 mg/L. Ten tests would be required using each of two different marker standards, one in the range of 0.1 to 1 mg/L and the other in the range of 4 to 10 mg/L of solvent yellow 124. Therefore, a minimum of 20 total tests would be required for sufficient demonstration of accuracy for a given marker test method at a given laboratory facility. Finally, any known interferences for a given test method would have to be mitigated. We are proposing that these tests be performed using commercially available solvent yellow 124 standards. Since the European Union's marker requirement would have been in effect for over six years and we expect this requirement to continue indefinitely, we believe that such standards would be available by the implementation date for this proposed rule. We request comment on this assessment and on whether we should allow facilities that conduct the proposed tests to blend up their own marker standards using a pure supply of the fuel marker.

We request comment on the proposed precision and accuracy criteria described above. These requirements are not intended be overly burdensome. To the contrary, we believe these requirements are equivalent to what a laboratory would do during the normal start up procedure for a given test method. In addition, we believe this approach would allow regulated entities to know that they are measuring fuel marker levels accurately and within reasonable site reproducibility limits.

2. What Information Would Have To Be Reported to the Agency?

As noted above, the European Union's (EU) marker requirement would have been in effect for over six years prior to the effective data for the proposed marker requirements and we expect the EU requirement to continue indefinitely. Thus, we anticipate that the European

[337] See Section VIII.D. of this proposal for a discussion of the methodology used in deriving the proposed precision and accuracy values for the sulfur test method.

testings standards community will likely have standardized a test procedure to measure the concentration of solvent yellow 124 in distillate fuels prior to the implementation of the proposed marker requirement. Given the limited duration of the proposed marker requirements, we do not anticipate that the United States testing standards community would enact such a standardized test procedure. To the extent that marker test methods that have already been approved by a voluntary consensus standards body[338] (VCSB), such as the International Standards Organization (ISO) or the American Society for Testing and Materials (ASTM), each laboratory facility would be required to report to the Agency the precision and accuracy results as described above for each method for which it is seeking approval. Such submissions to EPA, as described elsewhere, would be subject to the Agency's review for 30 days, and the method would be considered approved in the absence of EPA comment. Laboratory facilities would be required to retain the fuel samples used for precision and accuracy demonstration for a limited amount of time (e.g., 30 days).

For test methods that have not been approved by a VCSB, full test method documentation, including a description of the technology/instrumentation that makes the method functional, as well as subsequent EPA approval of the method would also be required. These submissions would also be subject to the Agency's review for 60 days, and the method would be considered approved in the absence of EPA comment. Submission of VCSB methods would not be required since they are available in the public domain. In addition, industry and the Agency have likely had substantial experience with such methods.

To assist the Agency in determining the performance of a given marker test method (non-VCSB methods, in particular), we propose to reserve the right to send samples of commercially available fuel to laboratories for evaluation. Such samples would be intended for situations in which the Agency had concerns regarding a test method and, in particular, its ability to measure the marker content of a random commercially available diesel fuel. Laboratory facilities would be required to report their results from three tests of this material to the Agency.

Given the limited duration of the proposed marker requirements, we are proposing that qualified test methods would remain valid for as long as the marker requirements remained in effect, provided that additional faults with the test method were not discovered. We are also proposing that ongoing Quality Control (QC) procedures for marker measurement instrumentation similar to those that we proposed for the sulfur test procedures in Section VIII.D above. We request comment on whether such QC procedures are needed for the marker test method.

F. Requirements for Recordkeeping, Reporting, and Product Transfer Documents

[338] These are standard-setting organizations, like ASTM, and ISO that have broad representation of all interested stakeholders and make decisions by consensus.

1. Registration of Refiners and Importers

By December 31, 2004, refiners and importers that may produce or supply NRLM diesel fuel by June 1, 2007 would be required to register with EPA. There would be no need to register if a refiner (and all its refineries), or an importer, is already registered under the highway diesel program. The registration would include the following information:

- Corporate name and address of the refiner or importer and any parent companies and a contact person
- Name and address of all refineries or import facilities (including, for importers, the PADD(s))
- A contact person
- Location of records
- Business activity (refiner or importer)
- Capacity of each refinery in barrels of crude oil per calendar day

2. Application for Small Refiner Status

We propose that an application of a refiner for small refiner status be submitted to EPA by June 1, 2005 and include the following information:

- The name and address of each location at which any employee of the company, including any parent companies or subsidiaries,[339] worked during the 12 months preceding January 1, 2003;

- The average number of employees at each location, based on the number of employees for each of the company's pay periods for the 12 months preceding January 1, 2003;

- The type of business activities carried out at each location; and

- The total crude oil refining capacity of the corporation. We define total capacity as the sum of all individual refinery capacities for multiple-refinery companies, including any and all subsidiaries, as reported to the Energy Information Administration (EIA) for 2002, or in the case of a foreign refiner, a comparable reputable source, such as professional publication or trade journal[340]. Refiners do not need to include crude oil capacity used in 2002 through a lease agreement with another refiner in which it has no ownership interest.

[339] "Subsidiary" here covers entities of which the parent company has 50 percent or greater ownership.

[340] We will evaluate each foreign refiner's documentation of crude oil capacity on an individual basis.

The crude oil capacity information reported to the EIA or comparable reputable source is presumed to be correct. However, in cases where a company disputes this information, we propose to allow 60 days after the company submits its application for small refiner status for that company to petition us with detailed data it believes shows that the EIA or other source's data was in error. We would consider this data in making a final determination about the refiner's crude oil capacity.

Small refinery facilities could not be approved for small refiner status unless the refinery produces diesel fuel from crude oil. This is because a small refiner's relief is intended to address the hardship encountered in making capital improvements to a crude oil refinery. No such costs are involved in operations that only blend previously refined products.

3. Applying for Refiner Hardship Relief

As discussed above in Section IV.C.2, a refiner seeking general hardship relief under the proposed program would apply to EPA and provide several types of financial and technical information, such as internal cash flow data and information on bank loans, bonds, and assets as well as detailed engineering and construction plans and permit status. Applications for hardship relief would be due June 1, 2005.

4. Applying for a Non-Highway Distillate Baseline Percentage

As discussed in Section IV above, we are proposing that refiners or importers wishing to fungibly distribute highway and NRLM fuel from any refinery or import facility apply to EPA for a non-highway baseline percentage for each such refinery or facility. Refiners or importers would provide EPA with data to quantify its annual average production or importation of distillate that was dyed for use in any non-highway application for each year during the period from January 1, 2003 through December 31, 2005. Specifically, this data would consist of the following for each batch of diesel fuel during this period:

- The date the refiner finished production of the batch
- The volume of the batch
- Whether the fuel in the batch was dyed

We propose that applications for non-highway baselines be submitted to EPA by February 28, 2006. We would act on these baselines by June 1, 2006, in time for the refiner or importer to earn early credits if they wished.

5. Pre-Compliance Reports

We believe that an early general understanding of the progress of the refining industry in complying with the proposed requirements would be valuable to both the affected industries and

EPA. As with the highway diesel program, we propose that each refiner and importer provide annual reports on the progress of and plans for each of their refineries or import facilities. These pre-compliance reports would be required by June 1 of each year beginning in 2005 and continuing up through 2010, or until the entity produced or imported any 15 ppm nonroad fuel, whichever is later.

EPA would maintain the confidentiality of information submitted in pre-compliance reports to the full extent authorized by law. We would report generalized summaries of this data following the receipt of the pre-compliance reports. We recognize that plans may change for many refiners or importers as the compliance dates approach. Thus, submission of the report would not impose an obligation to follow through on plans projected in the pre-compliance reports.

Pre-compliance reports could, at the discretion of the refiner/importer, be submitted in conjunction with the annual compliance reports proposed below and/or the pre-compliance and annual compliance reports required under the highway diesel program, so long as all information required in all reports is clearly provided.

In their pre-compliance reports, refiners and importers would need to include the following information:

- Any changes in their basic corporate or facility information since registration.
- Estimates of the volumes (in gallons) of each sulfur grade of highway and non-highway fuel produced (or imported) at each refinery (or facility). These volume estimates would be provided both for fuel produced from crude oil, as well as any fuel produced from other sources.
- For entities expecting to participate in the credit program, estimates of numbers of credits to be earned and/or used.
- Information regarding engineering plans such as design and construction, the status of obtaining any necessary permits, and capital commitments for making the necessary modifications to produce low sulfur nonroad diesel fuel, and actual construction progress.
- The pre-compliance reports in 2006 and later years must provide an update of the progress in each of these areas.

6. Annual Compliance Reports and Batch Reports for Refiners and Importers

After the nonroad diesel sulfur requirements begin on June 1, 2007, refiners and importers would be required to submit annual compliance reports for each refinery that demonstrated compliance with the proposed requirements. If a refiner produces 15 ppm or 500 ppm fuel early under the credit provisions, its annual compliance reporting requirement would begin on June 1 following the beginning of the early fuel production. These reporting requirements would sunset after all flexibility provisions end (i.e., 2012 for non-small refiners and 2014 for small refiners). Annual compliance reports would be due on August 31of the year.

A refiner's (for each refinery) or importer's annual compliance report would include the following information:

- Report demonstrating compliance with the applicable sulfur content requirements using the non-highway baseline percentage approach or demonstrating compliance using an alternative compliance option *e.g.*, a small refiner option or the option to dye all nonroad, locomotive/marine diesel fuel at the refinery, as applicable.
- Report on the generation, use, transfer and retirement of diesel sulfur credits. Credit transfer information would include the identification of the number of credits obtained from, or transferred to, each entity. Reports would also show the credit balance at the start of the period, and the balance at the end of the period. NRLM or nonroad diesel sulfur credit information would be required to be stated separately from highway diesel credit information since the 2 credit programs would be treated separately.
- Batch reports for each batch produced or imported providing information regarding volume, sulfur level, cetane/aromatics standard compliance and whether the fuel was dyed and/or marked. The certification that fuel was marked with the specified chemical marker at the refinery or import facility would apply to heating oil for the period June 1, 2007 through June 1, 2010 and to locomotive and marine fuel for the period June 1, 2010 thorough June 1, 2014.
- For a small refiner that elects to produce 15 ppm nonroad diesel fuel by June 1, 2006 and therefore is eligible for a limited relaxation in its interim small refiner gasoline sulfur standards, the annual reports would also include specific information on gasoline sulfur levels and progress toward highway and nonroad diesel desulfurization.

7. Product Transfer Documents (PTDs)

Today we are proposing that refiners and importers must provide information on commercial PTDs that would identify diesel fuel distributed for use in nonroad, locomotive, or marine equipment or motor vehicles, as appropriate, and state which sulfur standard the fuel is subject to. PTDs must state whether NRLM fuel complies with the 500 ppm sulfur standard or the 15 ppm sulfur standard. This would continue to be necessary even after 2010, since locomotive and marine engines could still use 500 ppm diesel fuel after all nonroad equipment would have to use 15 ppm fuel. Until all highway fuel sulfur content must meet the 15 ppm sulfur standard in 2010, it would be necessary for PTDs to indicate if 500 ppm fuel is dyed or undyed, and in all cases, PTDs would need to indicate if 15 ppm fuel is dyed or undyed, so that its appropriate use can be determined by transferees. Moreover, some nonroad diesel fuel, such as segregated small refiner fuel, could exceed the 15 ppm standard until as late as August 31, 2014; however, it could only be used in model year 2010 and earlier nonroad diesel engines.

We believe this additional information on commercial PTDs is necessary because of the importance of keeping the several sulfur grades and uses of diesel fuel separate from one another in the distribution system. Each party in the system would better be able to identify which type of fuel it is dealing with and could more effectively ensure that they were meeting the proposed requirements of the program. This in turn would help ensure that misfueling of sulfur sensitive engines does not occur and that the program would otherwise result in the needed emission reductions.

Except for transfers to truck carriers, retailers and wholesale purchaser-consumers, this proposal would allow use of product codes to convey the information. We believe that more explicit language on PTDs to these parties is necessary since employees of such parties are less likely to be aware of the meaning of product codes. PTDs would not be required for transfers of product into nonroad , locomotive, or marine equipment at retail outlets or wholesale purchaser-consumer facilities.

a. The Period from June 1, 2007 through May 31, 2010

During the first years of the program, unique PTDs would be required to distinguish the types of fuel that could be produced and sold and any restrictions on its use[341]:

- Undyed 500 ppm fuel
- Undyed 15 ppm fuel
- Dyed 500 ppm fuel (not for use in highway vehicles)
- Dyed 15 ppm fuel (not for use in highway vehicles)
- Dyed high-sulfur fuel (not for use in highway vehicles or certain nonroad engines)
- Marked heating oil (not for use in NRLM equipment or highway vehicles)

b. The Period from June 1, 2010 through May 31, 2014

Beginning June 1, 2010, unique PTDs would be required to distinguish the types of fuel that could be produced and sold during this period:

- Undyed 15 ppm
- Dyed 15 ppm fuel (not for use in highway vehicles)
- Dyed 500 ppm fuel (not for use in model year 2011 and later nonroad engines, or highway vehicles)
- Marked 500 ppm locomotive and marine fuel (not for use in nonroad equipment or highway vehicles)
- Heating oil (not for use in NRLM equipment or highway vehicles)

c. The Period After May 31, 2014

Beginning June 1, 2014, unique PTDs would be required to distinguish remaining types of fuel that could be produced and sold during this period.

- Undyed 15 ppm fuel
- Dyed 15 ppm fuel (not for use in highway vehicles)

[341] Note that for each time period discussed in this subsection, we expect few if any areas would be supplied with all the potential types of fuel listed.

- 500 ppm locomotive and marine fuel (not for use in nonroad equipment or highway vehicles)
- Heating oil (not for use in highway vehicles or NRLM equipment)

d. Kerosene and Other Distillates to Reduce Viscosity

To assure that downstream parties can determine the sulfur level of kerosene or other distillates that may be distributed for use for blending into 15 ppm highway or NRLM diesel fuel, e.g. to reduce viscosity in cold weather, this proposal would require that PTDs identify distillates specifically distributed for such use as meeting the 15 ppm standard.

e. Exported Fuel

Consistent with other fuels rules, NRLM diesel fuel to be exported from the U.S. would not be required to meet the sulfur content requirements of the proposed regulations. For example, where a refiner designates a batch of diesel fuel for export, and can demonstrate through commercial documents that the fuel was exported, that volume would not be used in calculating compliance with applicable baselines. Product transfer documents accompanying the transfer of custody or title to such fuel at each point in the distribution system would be required to state that the fuel is for export only and may not be used in the United States.

f. Additives

This proposal would require that PTDs for additives for use in nonroad diesel fuel state whether the additive complies with the 15 ppm sulfur standard. Like the highway diesel rule, this proposal would allow the sale of additives, for use by fuel terminals or other parties in the diesel fuel distribution system, that have a sulfur content greater than 15 ppm under specified conditions.

Under this proposal for additives that have a sulfur content not exceeding 15 ppm, the PTD would state: “The sulfur content of this additive does not exceed 15 ppm.”. For additives that have a sulfur content exceeding 15 ppm, the additive manufacturer's PTD, and PTDs accompanying all subsequent transfers, would provide: a warning that the additive's sulfur content exceeds 15 ppm; the maximum sulfur content of the additive; the maximum recommended concentration for use of the additive in diesel fuel, stated as gallon of additive per gallon of diesel fuel; and the increase in sulfur concentration of the fuel the additive will cause when used at the maximum recommended concentration.

We are also proposing provisions for additives sold to owner/operators for use in diesel powered nonroad equipment. This is because of the concern that additives designed for engines not requiring 15 ppm sulfur content fuel, such as locomotives or marine engines, could accidentally be introduced into nonroad engines if they have no label stating appropriate use. Under this proposal, end user additives for use in highway or NRLM diesel engines would be required to be accompanied by information that states that the additive either: complies with the 15 ppm sulfur content requirements or that it has a sulfur content exceeding 15 ppm and is not for use in model year 2011 or later nonroad diesel equipment. We believe this information is necessary for end users to determine if an additive is appropriate for nonroad equipment use.

8. Recordkeeping Requirements

Under the highway rule, refiners that produce or importers that import highway diesel fuel must maintain the following records for each batch of diesel fuel produced or imported) The batch designations; the applicable sulfur content standard; whether the fuel is dyed or undyed; whether the fuel is marked or unmarked; the batch volumes; whether the fuel was dyed or undyed, and sampling and testing records. The refiner or importer would also be required to maintain records regarding credit generation, use, transfer, purchase, or termination, separately for highway and nonroad credit programs.

We propose that these requirements from the highway rule be applied to all nonroad, locomotive, and marine diesel fuel subject to this rule as well.

9. Record Retention

This proposal would adopt a retention period of 5 years for all records required to be kept by the rule. This is the same period of time required in other fuels rules, and it coincides with the applicable statute of limitations. We believe that for other reasons, most parties in the distribution system would maintain some or all of these records for this length of time even without the requirement.

This retention period would apply to PTDs, records of any test results performed by any regulated party for quality assurance purposes or otherwise (whether or not such testing was required by this rule), along with supporting documentation such as date of sampling and testing, batch number, tank number, and volume of product. Business records regarding actions taken in response to any violations discovered would also be required to be maintained for 5 years.

All records required to be maintained by refiners or importers participating in the generation or use of credits, hardship options (or by importers of diesel fuel produced by a foreign refiner approved for the temporary compliance option or a hardship option), including small refiner options, would also be covered by the retention requirement.

G. Liability and Penalty Provisions for Noncompliance

1. General

The liability and penalty provisions of the proposed NRLM diesel sulfur rule would be very similar to the liability and penalty provisions found in the highway diesel sulfur rule, the gasoline sulfur rule, the RFG rule and other EPA fuels regulations.[342] Regulated parties would be subject to prohibitions which are typical in EPA fuels regulations, such as prohibitions on selling or distributing fuel that does not comply with the applicable standard, and causing others to commit prohibited acts. Liability would also arise under the NRLM diesel rule for prohibited acts specific to the diesel sulfur control program, such as introducing nonroad diesel fuel not meeting the 15 ppm sulfur standard into model year 2011 or later nonroad equipment. In addition, parties would be liable for a failure to meet certain requirements, such as the recordkeeping, reporting, or PTD requirements, or causing others to fail to meet such requirements.

Under this proposal, the party in the diesel fuel distribution system that controls the facility where a violation occurred, and other parties in that fuel distribution system (such as the refiner, reseller, and distributor), would be presumed to be liable for the violation.[343] As in the Tier 2 gasoline sulfur rule and the highway diesel fuel rule, the proposed rule would explicitly prohibit causing another person to commit a prohibited act or causing non-conforming diesel fuel to be in the distribution system. Non-conforming includes: (1) diesel fuel with sulfur content above 15 ppm incorrectly designated as appropriate for model year 2011 or later nonroad equipment or other engines requiring 15 ppm fuel; (2) diesel fuel with sulfur content above 500 ppm incorrectly designated as appropriate for nonroad equipment or locomotives or marine engines after the applicable date for the 500 ppm standard for these pieces of equipment; or (3) distillates not containing required markers or otherwise not complying with the requirements of this proposal. Parties outside the diesel fuel distribution system, such as diesel additive manufacturers and distributors, would also be subject to liability for those diesel rule violations which could have been caused by their conduct.

This proposal also would provide affirmative defenses for each party presumed liable for a violation, and all presumptions of liability would be rebuttable. In general, in order to rebut the presumption of liability, parties would be required to establish that: (1) the party did not cause the violation; (2) PTD(s) exist which establish that the fuel or diesel additive was in compliance while under the party's control; and (3) the party conducted a quality assurance sampling and testing program. As part of their affirmative defense diesel fuel refiners or importers, diesel fuel additive manufacturers, and blenders of high sulfur additives into diesel fuel, would also be required to provide test results establishing the conformity of the product prior to leaving that party's control. Branded refiners would have additional affirmative defense elements to establish. The proposed defenses under the nonroad diesel sulfur rule are similar to those available to parties for violations of the highway diesel sulfur, RFG, gasoline volatility, and the gasoline sulfur regulations. This proposed rule would also clarify that parent corporations are liable for violations of subsidiaries, in a manner consistent with the gasoline sulfur rule and the highway diesel sulfur rule. Finally,

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[342] See section 80.5 (penalties for fuels violations); section 80.23 (liability for lead violations); section 80.28 (liability for gasoline volatility violations); section 80.30 (liability for highway diesel violations); section 80.79 (liability for violation of RFG prohibited acts); section 80.80 (penalties for RFG/CG violations); section 80.395 (liability for gasoline sulfur violations); section 80.405 (penalties for gasoline sulfur regulations).; and section 80.610-614 (prohibited acts, liability for violations, and penalties for highway diesel sulfur regulations.

[343] An additional type of liability, vicarious liability, is also imposed on branded refiners under the proposal.

the proposed NRLM diesel sulfur rule mirrors the gasoline sulfur rule and the highway diesel sulfur rule by clarifying that each partner to a joint venture would be jointly and severally liable for the violations at the joint venture facility or by the joint venture operation.

As is the case with the other EPA fuels regulations, the proposed diesel sulfur rule would apply the provisions of section 211(d)(1) of the Clean Air Act (Act) for the collection of penalties. These penalty provisions currently subject any person that violates any requirement or prohibition of the diesel sulfur rule to a civil penalty of up to $31,500 for every day of each such violation and the amount of economic benefit or savings resulting from the violation. A violation of a NRLM diesel sulfur standard would constitute a separate day of violation for each day the diesel fuel giving rise to the violation remains in the fuel distribution system. Under the proposed regulation, the length of time the diesel fuel in question remains in the distribution system is deemed to be twenty-five days unless there is evidence that the fuel remained in its distribution system a lesser or greater amount of time. This is the same time presumption that is incorporated in the RFG, gasoline sulfur and highway diesel sulfur rules. The penalty provisions would also be similar to the penalty provisions for violations of these regulations.

EPA has included in this proposal two prohibitions for "causing" violations: (1) causing another to commit a violation; and (2) causing non-complying diesel fuel to be in the distribution system. These causation prohibitions are like similar prohibitions included in the gasoline sulfur and the highway diesel sulfur regulations, and, as discussed in the preamble to those rules, EPA believes they are consistent with EPA's implementation of prior motor vehicle fuel regulations. See the liability discussion in the preamble to the gasoline sulfur final rule, at 65 FR 6812 *et seq*.

The prohibition against causing another to commit a violation would apply where one party's violation is caused by the actions of another party. For example, EPA may conduct an inspection of a terminal and discover that the terminal is offering for sale nonroad diesel fuel designated as complying with the 15 ppm sulfur standard, while it, in fact, had an actual sulfur content greater than the standard.[344] In this scenario, parties in the fuel distribution system, as well as parties in the distribution system of any diesel additive that had been blended into the fuel, would be presumed liable for causing the terminal to be in violation. Each party would have the right to present an affirmative defense to rebut this presumption.

The prohibition against causing non-complying diesel fuel to be in the distribution system would apply, for example, if a refiner transfers non-complying diesel fuel to a pipeline. This prohibition could encompass situations where evidence shows high sulfur diesel fuel was transferred from an upstream party in the distribution system, but EPA may not have test results to establish that parties downstream also violated a prohibited act with this fuel.

The Agency would expect to enforce the liability scheme of the NRLM diesel sulfur rule in the same manner that we have enforced the similar liability schemes in our prior fuels

[344] At downstream locations the violation would occur if EPA's test result showed a sulfur content of greater than 17 ppm, which takes into account the two ppm adjustment factor for testing reproducibility for downstream parties.

regulations. As in other fuels programs, we would attempt to identify the party most responsible for causing the violation, recognizing that party should primarily be liable for penalties for the violation.

2. What are the Proposed Liability Provisions for Additive Manufacturers and Distributors, and Parties That Blend Additives into Diesel Fuel?

a. General

The final highway diesel rule permits the blending of diesel additives with sulfur content in excess of 15 ppm into 15 ppm highway diesel fuel under limited circumstances. As more fully discussed earlier in this preamble, this proposed rule would permit downstream parties to blend fuel additives having a sulfur content exceeding 15 ppm into 15 ppm nonroad diesel, provided that: (1) the blending of the additive does not cause the diesel fuel's sulfur content to exceed the 15 ppm sulfur standard; (2) the additive is added in an amount no greater than one volume percent of the blended product; and (3) the downstream party obtained from its additive supplier a product transfer document ("PTD") with the additive's sulfur content and the recommended treatment rate, and that it complied with such treatment rate.

Since the proposed rule would permit the limited use in nonroad diesel fuel of additives with high sulfur content, the Agency believes it would be more likely that a diesel fuel sulfur violation could be caused by the use of high sulfur additives. This could result from the additive manufacturer's misrepresentation or inaccurate statement of the additive's sulfur content or recommended treat rate on the additive's PTD, or an additive distributor's contamination of low sulfur additives with high sulfur additives during transportation. The increased probability that parties in the diesel additive distribution system could cause a violation of the sulfur standard warrants the imposition by the Agency of increased liability for such parties. Therefore, the proposed rule, like the final highway diesel rule, would explicitly make parties in the diesel additive distribution system liable for the sale of nonconforming diesel fuel additives, even if such additives have not yet been blended into diesel fuel. In addition, the proposed rule would impose presumptive liability on parties in the additive distribution system if diesel fuel into which the additive has been blended is determined to have a sulfur level in excess of its permitted concentration. This presumptive liability would differ depending on whether the blended additive was designated as meeting the 15 ppm sulfur standard (a "15 ppm additive") or designated as a greater than 15 ppm sulfur additive (a "high sulfur additive"), as discussed below.

b. Liability When the Additive Is Designated as Complying with the 15 ppm Sulfur Standard

Additives blended into diesel fuel downstream of the refinery would be required to have a sulfur content no greater than 15 ppm, and be accompanied by PTD(s) accurately identifying them as complying with the 15 ppm sulfur standard, with the sole exception of diesel additives blended into nonroad diesel fuel at a concentration no greater than one percent by volume of the blended fuel.

All parties in the fuel and additive distribution systems would be subject to presumptive liability if the blended fuel exceeds the sulfur standard. The two ppm downstream adjustment would apply when EPA tests the fuel subject to the 15 ppm sulfur standard. Low sulfur additives present a less significant threat to diesel fuel sulfur compliance than would occur with the use of additives designated as possibly exceeding 15 ppm sulfur. Thus, parties in the additive distribution system of the low sulfur additive could rebut the presumption of liability by showing the following: (1) additive distributors would only be required to produce PTDs stating that the additive complies with the 15 ppm sulfur standard; (2) additive manufacturers would also be required to produce PTDs complying in an accurate manner with the regulatory requirements, as well as producing test results, or retained samples on which tests could be run, establishing the additive's compliance with the 15 ppm sulfur standard prior to leaving the manufacturer's control. Once their presumptive liability was refuted by producing such documentation in a convincing manner, these additive system parties would only be held responsible for the diesel fuel non-conformity in situations in which EPA can establish that the party actually caused the violation.

Under this proposed rule, parties in the diesel fuel distribution system would have the typical affirmative defenses of other fuels rules. For parties blending an additive into their diesel fuel, the requirement of producing PTDs showing that the product complied with the regulatory standards would necessarily include PTDs for the additive that was used, affirming the compliance of the additive and the fuel.

c. Liability When the Additive Is Designated as Having a Possible Sulfur Content Greater than 15 ppm

Under this proposed rule, a nonroad diesel additive would be permitted to have a maximum sulfur content above 15 ppm if the blended fuel continues to meet the 15 ppm standard and the additive is used at a concentration no greater than one volume percent of the blended fuel. However, if nonroad diesel fuel containing that additive is found by EPA to have high sulfur content, then all the parties in both the additive and the fuel distribution chains would be presumed liable for causing the nonroad diesel fuel violation.

Since this type of high sulfur additive presents a much greater probability of causing diesel fuel non-compliance, parties in the additive's distribution system would have to satisfy an additional element to establish an affirmative defense. In addition to the elements of an affirmative defense described above, parties in the additive distribution system for such a high sulfur additive would also be required to establish that they did not cause the violation, an element of an affirmative defense that is typically required in EPA fuel programs to rebut presumptive liability.

Parties in the diesel fuel distribution system would essentially have to establish the same affirmative elements as in other fuels rules, with an addition comparable to the highway diesel rule. Blenders of high sulfur additives into 15 ppm sulfur nonroad diesel fuel, would have to establish a more rigorous quality control program than would exist without the addition of such a high sulfur additive. The Agency believes that parties blending high sulfur additives into their 15 ppm sulfur nonroad diesel fuel should be required to produce test results establishing that the blended fuel was in compliance with the 15 ppm sulfur standard after being blended with the high sulfur additive. This additional defense element would be required as an added safeguard to ensure nonroad diesel fuel compliance, since the blender has voluntarily chosen to use an additive which increases the risk of diesel fuel non-compliance.

H. How Would Compliance with the Sulfur Standards Be Determined?

EPA is today proposing that compliance with the diesel sulfur standards would be determined based on the sulfur level of the diesel fuel, as measured using a testing methodology approved under the provisions discussed in Section VIII.D of this preamble. We further propose that any evidence from any source or location could be used to establish the diesel fuel sulfur level, provided that such evidence is relevant to whether the level would have been in compliance if the regulatory sampling and testing methodology had been correctly performed. This is consistent with the approach taken under the gasoline sulfur rule and the highway diesel sulfur rule.

The proposed regulations would provide that the primary determinant of compliance with the sulfur standards would be use of an approved test method. Additionally, other information could be used under the proposed rule, including test results using a non-approved method, if the evidence is relevant to determining whether the sulfur level would meet applicable standards had compliance been determined using an approved test methodology. While the use of such a non-approved method might produce results relevant to determining sulfur content, this would not remove any liability for failing to conduct required batch testing using an approved test method.

For example, the Agency might not have sulfur results derived from an approved test method for diesel fuel sold by a terminal, yet the terminal's own test results, based on testing using methods other than those approved under the regulations, could reliably show an exceedence of the sulfur standard. Under this proposed rule, evidence from the non-approved test method could be used to establish the diesel fuel's sulfur level that would have resulted if an approved test method had been conducted. This type of evidence is available for use by either the EPA or the regulated party, and could be used to show either compliance or noncompliance. Similarly, absent the existence of sulfur test results using an approved method, commercial documents asserting the sulfur level of diesel fuel or additive could be used as some evidence of what the sulfur level of the fuel would be if the product would have been tested using an approved method.

The Agency believes that the same statutory authority for EPA to adopt the gasoline sulfur rule's evidentiary provisions, Clean Air Act section 211(c), provides appropriate authority for our proposal of the evidentiary provisions of today's diesel sulfur rule. For a fuller explanation of this statutory authority, see Section VI(I) of the gasoline sulfur final rule preamble, 65 FR 6815, February 10, 2000.

IX. Public Participation

We request comment on all aspects of this proposal. This section describes how you can participate in this process.

A. How and to Whom Do I Submit Comments?

We are opening a formal comment period by publishing this document. We will accept comments for the period indicated under "DATES" above. If you have an interest in the program described in this document, we encourage you to comment on any aspect of this rulemaking. We request comment on various topics throughout this proposal.

Your comments will be most useful if you include appropriate and detailed supporting rationale, data, and analysis. If you disagree with parts of the proposed program, we encourage you to suggest and analyze alternate approaches to meeting the air quality goals described in this proposal. You should send all comments, except those containing proprietary information, to our Air Docket (see "Addresses") before the end of the comment period.

You may submit comments electronically, by mail, or through hand delivery/courier. To ensure proper receipt by EPA, identify the appropriate docket identification number in the subject line on the first page of your comment. Please ensure that your comments are submitted within the specified comment period. Comments received after the close of the comment period will be marked "late." EPA is not required to consider these late comments. If you wish to submit CBI or information that is otherwise protected by statute, please follow the instructions in Section IX.B. Do not use EPA Dockets or e-mail to submit CBI or information protected by statute.

1. Electronically

If you submit an electronic comment as prescribed below, EPA recommends that you include your name, mailing address, and an e-mail address or other contact information in the body of your comment. Also include this contact information on the outside of any disk or CD ROM you submit, and in any cover letter accompanying the disk or CD ROM. This ensures that you can be identified as the submitter of the comment and allows EPA to contact you in case EPA cannot read your comment due to technical difficulties or needs further information on the substance of your comment. EPA's policy is that EPA will not edit your comment, and any identifying or contact information provided in the body of a comment will be included as part of the comment that is placed in the official public docket, and made available in EPA's electronic public docket. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment.

i. EPA Dockets

Your use of EPA's electronic public docket to submit comments to EPA electronically is EPA's preferred method for receiving comments. Go directly to EPA Dockets at http://www.epa.gov/edocket, and follow the online instructions for submitting comments. To access EPA's electronic public docket from the EPA Internet Home Page, select "Information Sources," "Dockets," and "EPA Dockets." Once in the system, select "Quick Search," and then key in Docket ID No. OAR-2003-0012. The system is an "anonymous access" system, which means EPA will not know your identity, e-mail address, or other contact information unless you provide it in the body of your comment.

ii. E-mail

Comments may be sent by electronic mail (e-mail) to nrt4@epa.gov, Attention Docket ID No. A-2001-28. In contrast to EPA's electronic public docket, EPA's e-mail system is not an "anonymous access" system. If you send an e-mail comment directly to the Docket without going through EPA's electronic public docket, EPA's e-mail system automatically captures your e-mail address. E-mail addresses that are automatically captured by EPA's e-mail system are included as part of the comment that is placed in the official public docket, and made available in EPA's electronic public docket.

iii. Disk or CD ROM

You may submit comments on a disk or CD ROM that you mail to the mailing address identified in Section IX.A.2 below. These electronic submissions will be accepted in WordPerfect or ASCII file format. Avoid the use of special characters and any form of encryption.

2. By Mail

Send your comments to: Air Docket, Environmental Protection Agency, Mailcode: 6102T, 1200 Pennsylvania Ave., NW, Washington, DC, 20460, Attention Docket ID No. A-2001-28.

3. By Hand Delivery or Courier

Deliver your comments to: EPA Docket Center, (EPA/DC) EPA West, Room B102, 1301 Constitution Ave., NW, Washington, DC., Attention Docket ID No. A-2001-28. Such deliveries are only accepted during the Docket's normal hours of operation from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays.

B. How Should I Submit CBI To the Agency?

Do not submit information that you consider to be CBI electronically through EPA's electronic public docket or by e-mail. Send or deliver information identified as CBI only to the following address: U.S. Environmental Protection Agency, Assessment and Standards Division, 2000 Traverwood Drive, Ann Arbor, MI, 48105, Attention Docket ID No. A-2001-28. You may claim information that you submit to EPA as CBI by marking any part or all of that information as CBI (if you submit CBI on disk or CD ROM, mark the outside of the disk or CD ROM as CBI and then identify electronically within the disk or CD ROM the specific information that is CBI). Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2.

In addition to one complete version of the comment that includes any information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket and EPA's electronic public docket. If you submit the copy that does not contain CBI on disk or CD ROM, mark the outside of the disk or CD ROM clearly that it does not contain CBI. Information not marked as CBI will be included in the public docket and EPA's electronic public docket without prior notice. If you have any questions about CBI or the procedures for claiming CBI, please consult the person identified in the FOR FURTHER INFORMATION CONTACT section.

C. Will There Be a Public Hearing?

We will hold three public hearings; in Los Angeles, Chicago, and New York City. The hearings will be held on the following dates and start at the following times, and continue until everyone present has had an opportunity to speak.

Hearing Location	**Date**	**Time**
New York, New York Park Central New York 870 Seventh Avenue at 56th Street New York, NY 10019 Telephone: (212) 247-8000 Fax: (212) 541-8506	June 10, 2003	9:00 a.m. EDT
Chicago, Illinois Hyatt Regency O'Hare 9300 W. Bryn Mawr Avenue Rosemont, IL 60018 Telephone: (847) 696-1234 Fax: (847) 698-0139	June 12, 2003	9:00 a.m. CDT
Los Angeles. California Hyatt Regency Los Angeles 711 South Hope Street Los Angeles, California, USA. 90017 Telephone: (213) 683-1234 Fax: (213) 629-3230	June 17, 2003	9:00 a.m. PDT

If you would like to present testimony at a public hearing, we ask that you notify the contact person listed above at least ten days before the hearing. You should estimate the time you will need for your presentation and identify any needed audio/visual equipment. We suggest that you bring copies of your statement or other material for the EPA panel and the audience. It would also be helpful if you send us a copy of your statement or other materials before the hearing.

We will make a tentative schedule for the order of testimony based on the notifications we receive. This schedule will be available on the morning of each hearing. In addition, we will reserve a block of time for anyone else in the audience who wants to give testimony.

We will conduct the hearing informally, and technical rules of evidence won't apply. We will arrange for a written transcript of the hearing and keep the official record of the hearing open for 30 days to allow you to submit supplementary information. You may make arrangements for copies of the transcript directly with the court reporter.

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D. Comment Period

The comment period for this rule will end on **August 20, 2003**.

E. What Should I Consider as I Prepare My Comments for EPA?

You may find the following suggestions helpful for preparing your comments:

1. Explain your views as clearly as possible.
2. Describe any assumptions that you used.
3. Provide any technical information and/or data you used that support your views.
4. If you estimate potential burden or costs, explain how you arrived at your estimate.
5. Provide specific examples to illustrate your concerns.
6. Offer alternatives.
7. Make sure to submit your comments by the comment period deadline identified.
8. To ensure proper receipt by EPA, identify the appropriate docket identification number in the subject line on the first page of your response. It would also be helpful if you provided the name, date, and **Federal Register** citation related to your comments.

X. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review

Under Executive Order 12866 (58 FR 51735, October 4, 1993), the Agency must determine whether the regulatory action is "significant" and therefore subject to review by the Office of Management and Budget (OMB) and the requirements of this Executive Order. The Executive Order defines a "significant regulatory action" as any regulatory action that is likely to result in a rule that may:

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, Local, or Tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs, or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

A draft Regulatory Impact Analysis has been prepared and is available in the docket for this rulemaking and at the internet address listed under **"How Can I Get Copies of This Document and Other Related Information?"** above. This action was submitted to the Office of Management and Budget for review under Executive Order 12866. Estimated annual costs of this rulemaking are estimated to be $1.2 billion per year, thus this proposed rule is considered economically significant. Written comments from OMB and responses from EPA to OMB comments are in the public docket for this rulemaking.

B. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. The Agency proposes to collect information to ensure compliance with the provisions in this rule. This includes a variety of requirements, both for engine manufacturers and for fuel producers. Information-collection requirements related to engine manufacturers are in EPA ICR #1897.05; requirements related to fuel producers are in EPA ICR #1718.05. Section 208(a) of the Clean Air Act requires that manufacturers provide information the Administrator may reasonably require to determine compliance with the regulations; submission of the information is therefore mandatory. We will consider confidential all information meeting the requirements of section 208(c) of the Clean Air Act.

As shown in Table X-1, the total annual burden associated with this proposal is about 215,000 hours and $16 million, based on a projection of 470 respondents. The estimated burden for engine manufacturers is a total estimate for both new and existing reporting requirements. The fuel-related requirements represent our first regulation of nonroad diesel fuel, so those burden estimates reflect only new reporting requirements. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; and transmit or otherwise disclose the information.

TABLE X-1 -- ESTIMATED BURDEN FOR REPORTING AND RECORDKEEPING REQUIREMENTS

Industry Sector	Number of Respondents	Annual burden hours	Annual costs
Engines	95	160,000	$12.5 million
Fuels	375	55,000	$3.7 million
Total	470	215,000	$16.2 million

An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations are listed in 40 CFR part 9 and 48 CFR chapter 15.

Comments are requested on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques. Send comments on the ICR to the Director, Collection Strategies Division; U.S. Environmental Protection Agency (2822); 1200 Pennsylvania Ave., NW; Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, 725 17th St., NW, Washington, DC 20503, marked "Attention: Desk Officer for EPA." Include the ICR number in any correspondence. Since OMB is required to make a decision concerning the ICR between 30 and 60 days after **[Insert date of publication in the FEDERAL REGISTER]**, a comment to OMB is best ensured of having its full effect if OMB receives it by **[Insert date 30 days after publication in the FEDERAL REGISTER]**. The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

C. Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), 5 USC 601 et. seq

1. Overview

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis for any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For the purposes of assessing the impacts of today's rule on small entities, a small entity is defined as: (1) a small business that meets the definitions based on the Small Business Administration's (SBA) size standards (see table below); (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field. The following table provides an overview of the primary SBA small business categories potentially affected by this regulation:

Industry	**Defined as small entity by SBA if:**	**Major SIC[a] Codes**
Engine manufacturers	Less than 1,000 employees	Major Group 35
Equipment manufacturers:		
- construction equipment	Less than 750 employees	Major Group 35
- industrial truck manufacturers (i.e. forklifts)	Less than 750 employees	Major Group 35
- all other nonroad equipment manufacturers	Less than 500 employees	Major Group 35
Fuel refiners	Less than 1500 employees[b]	2911
Fuel distributors	<varies>	<varies>

Notes:
[a] Standard Industrial Classification
[b] EPA has included in past fuels rulemakings a provision that, in order to qualify for the small refiner flexibilities, a refiner must also have a company-wide crude refining capacity of no greater than 155,000 barrels per calendar day. EPA has included this criterion in the small refiner definition for a nonroad diesel sulfur program as well.

2. Background

Controlling emissions from nonroad engines and equipment, in conjunction with diesel fuel quality controls, has very significant public health and welfare benefits, as explained in

Section II of this preamble. We are proposing new engine standards and related provisions under sections 213(a)(3) and (4) of the Clean Air Act which, among other things, direct us to establish (and from time to time revise) emission standards for new nonroad diesel engines. Similarly, section 211(c)(1) authorizes EPA to regulate fuels if any emission product of the fuel causes or contributes to air pollution that may endanger public health or welfare, or that may impair the performance of emission control technology on engines and vehicles.

In accordance with Section 603 of the RFA, EPA prepared an initial regulatory flexibility analysis (IRFA) that examines the impact of the proposed rule on small entities along with regulatory alternatives that could reduce that impact. The IRFA is available for review as part of the draft RIA for the rule. This is available in the public docket and is summarized below.

3. Summary of Regulated Small Entities

The following section discusses the small entities directly regulated by this proposed rule.

a. Nonroad Diesel Engine Manufacturers

Using information from the industry profile that was conducted for the nonroad diesel sector, EPA identified a total of 61 engine manufacturers. The top 10 engine manufacturers comprise 80 percent of the total market, while the other 51 companies make up the remaining 20 percent[345]. Of the 61 manufacturers, four fit the SBA definition of a small entity. These four manufacturers were Anadolu Motors, Farymann Diesel GMBH, Lister-Petter Group, and V & L Tools (parent company of Wisconsin Motors LLC, formerly 'Wis-Con Total Power'). These businesses comprise 8 percent of the total engine sales for the year 2000.

b. Nonroad Diesel Equipment Manufacturers

To determine the number of equipment manufacturers, EPA also used the industry profile that was conducted. From this, EPA identified over 700 manufacturers with sales and/or employment data that could be included in the screening analysis. These businesses included manufacturers in the construction, agricultural, and outdoor power equipment (mainly, lawn and garden equipment) sectors of the nonroad diesel market. The equipment produced by these manufacturers ranged from small walk-behind equipment (sub-25 hp engines) to large mining and construction equipment (using engines in excess of 750 hp). Of the manufacturers with available sales *and* employment data (approximately 500 manufacturers), small equipment manufacturers represent 68 percent of total equipment manufacturers (and these manufacturers account for 11 percent of nonroad diesel equipment industry sales). Thus, the majority of the small entities that could potentially experience a significant impact as a result of this rulemaking are in the nonroad equipment manufacturing sector.

[345] All sales information used for this analysis was 2000 data.

c. Nonroad Diesel Fuel Refiners

Our current assessment is that 26 refiners (collectively owning 33 refineries) meet SBA's definition of a small business for the refining industry. The 33 refineries appear to meet both the employee number and production volume criteria mentioned above. These small refiners currently produce approximately 6 percent of the total high-sulfur diesel fuel. It should be noted that because of the dynamics in the refining industry (e.g., mergers and acquisitions), the actual number of refiners that ultimately qualify for small refiner status under a future nonroad diesel sulfur program could be different than this initial estimate.

d. Nonroad Diesel Fuel Distributors and Marketers

The industry that transports, distributes, and markets nonroad diesel fuel encompasses a wide range of businesses, including bulk terminals, bulk plants, fuel oil dealers, and diesel fuel trucking operations, and totals thousands of entities that have some role in this activity. More than 90 percent of these entities would meet small entity criteria. Common carrier pipeline companies are also a part of the distribution system; 10 of them are small businesses.

4. Potential Reporting, Record Keeping, and Compliance

As with any emission control program, the Agency must have the assurance that the regulated entities will meet the emissions standards and all related provisions. For engine and equipment manufacturers, EPA is proposing to continue the reporting, recordkeeping, and compliance requirements prescribed for these categories in 40 CFR part 89. Key among these are certification requirements and provisions related to reporting of production, emissions information, use of transition provisions, etc.

For any fuel control program, EPA must have the assurance that fuel produced by refiners meets the applicable standard, and that the fuel continues to meet the standard as it passes downstream through the distribution system to the ultimate end user. This is particularly important in the case of diesel fuel, where the aftertreatment technologies expected to be used to meet the engine standards under consideration are highly sensitive to sulfur. The recordkeeping, reporting and compliance provisions of the proposed rule are fairly consistent with those in place today for other fuel programs, including the current 15 ppm highway diesel regulation. For example, recordkeeping involves the use of product transfer documents, which are already required under the 15 ppm highway diesel sulfur rule (40 CFR 80.560).

5. Relevant Federal Rules

The proposed certification fees rule, through the Agency's Certification and Compliance Division (CCD), may have some impact on the upcoming rule, and the Panel recommended that we take into consideration the effects that this rule may have on small businesses.

The fuel regulations that we expect to propose would be similar in many respects to the existing sulfur standard for highway diesel fuel. We are not aware of any area where the regulations under consideration would directly duplicate or overlap with the existing federal, state, or local regulations; however, several small refiners will also be subject to the gasoline sulfur and highway diesel sulfur control requirements, as well as air toxics requirements.

More stringent nonroad diesel sulfur standards may require some refiners to obtain permits from state and local air pollution control agencies under the Clean Air Act's New Source Review program prior to constructing the desulfurization equipment needed to meet the standards.

The Internal Revenue Service (IRS) has an existing rule that levies taxes on highway diesel fuel only. The rule requires that nonroad diesel (un-taxed) fuel be dyed so that regulators and customers will know which type of fuel is which. Because of the need to separate dyed from undyed diesel fuel, some marketers may choose to install extra tanks. Therefore, fuel marketers have claimed that, if two grades of nonroad fuel are allowed in the marketplace, they may decide to maintain two segregated tanks for both nonroad (dyed 500 ppm and dyed 15 ppm) and highway diesel fuels (undyed 500 ppm and undyed 15 ppm), during the transition periods for both of these fuels.

6. Summary of SBREFA Panel Process and Panel Outreach

a. Significant Panel Findings

The Small Business Advocacy Review Panel (SBAR Panel, or the Panel) considered many regulatory options and flexibilities that would help mitigate potential adverse effects on small businesses as a result of this rule. During the SBREFA Panel process, the Panel sought out and received comments on the regulatory options and flexibilities that were presented to SERs and Panel members. The major flexibilities and hardship relief provisions that are recommended by the Panel, along with specific recommendations by individual Panel members, are described below and are also located in Section 9 of the SBREFA Final Panel Report which is available in the public docket.[346]

b. Panel Process

As required by section 609(b) of the RFA, as amended by SBREFA, we also conducted outreach to small entities and convened a SBAR Panel to obtain advice and recommendations of representatives of the small entities that potentially would be subject to the rule's requirements.

On October 24, 2002, EPA's Small Business Advocacy Chairperson convened a Panel under Section 609(b) of the RFA. In addition to the Chair, the Panel consisted of the Deputy

[346] Final Panel Report of the Small Business Advocacy Review Panel on EPA's Proposed Rule- Control of Emissions of Air Pollution From Land-Based Nonroad Compression Ignition Engines, December 23, 2003.

Director of EPA's Office of Transportation and Air Quality, the Chief Counsel for Advocacy of the Small Business Administration, and the Administrator of the Office of Information and Regulatory Affairs within the Office of Management and Budget. As part of the SBAR Panel process, we conducted outreach with representatives from the various small entities that would be affected by the proposed rulemaking. We met with these Small Entity Representatives (SERs) to discuss the potential rulemaking approaches and ways to decrease the impact of the rulemaking on their industries. We distributed outreach materials- including background on the nonroad diesel sector, possible regulatory approaches, and possible rulemaking alternatives- to the SERs on October 30, 2002. On November 13, 2002 the Panel met with the SERs to discuss the outreach materials and receive initial feedback on the approaches and alternatives detailed in the outreach packet. The Panel received written comments from the SERs following the meeting in response to discussions had at the meeting and the questions posed to the SERs by the Agency. The SERs were specifically asked to provide comment on regulatory alternatives that could help to minimize the impact on small businesses as a result of the rulemaking.

In general, SERs representing the nonroad diesel equipment manufacturers raised concerns about the added cost of compliance and the increase in size of compliant engines (and how this would affect their products). SERs representing the nonroad diesel fuel industry raised comments that generally included anticipated difficulty in going to a lower grade of fuel and the need for increased tankage to carry interim grades of fuel. All SERs raised concerns that small entities do not have the capital and have fewer resources which make compliance difficult. Thus, they maintain that there is a need to provide alternatives and provisions to address these issues, as (per their view) more stringent emission standards could impose more significant adverse impacts on small entities than on large businesses. (For the most part, EPA has not found the facts to support these contentions in this proposal, and thus is not proposing separate provisions applicable only to small entities.)

The Panel's findings and discussions are based on the information that was available during the term of the Panel and issues that were raised by the SERs during the outreach meetings and in their comments. It was agreed that EPA should consider the issues raised by the SERs (and discussions had by the Panel itself) and that EPA should consider comments on flexibility alternatives that would help to mitigate any negative impacts on small businesses. Alternatives discussed throughout the Panel process include those offered in previous or current EPA rulemakings, as well as alternatives suggested by SERs and Panel members, and the Panel recommended that all bee considered in the development of the rule. Though some of the flexibilities suggested may be appropriate to apply to all entities affected by the rulemaking, the Panel's discussions and recommendations are focused mainly on the impacts, and ways to mitigate adverse impacts, on small businesses. In addition some of the provisions, such as the equipment manufacturer transition provision, that apply to all entities also help to mitigate the effects on small entities. A summary of these recommendations is detailed below, and a full discussion of the regulatory alternatives and hardship provisions discussed and recommended by the Panel can be found in the SBREFA Final Panel Report. A complete discussion of the transition and hardship provisions that we are proposing in today's action can be found in Sections VII.C and III.A of this preamble. Also, the Panel Report includes all comments received from SERs (Appendix B of the Report), a summary of those comments (Section 8), and summaries of the two outreach meetings that were held with the SERs (Appendices C and D). In accordance with the RFA/SBREFA requirements, the Panel evaluated the aforementioned materials and SER comments on issues related to the Initial Regulatory Flexibility Analysis (IRFA). The following sections describe the Panel recommendations, along with specific recommendations by individual Panel members, from the SBAR Panel Report.

c. Transition Flexibilities

The Panel recommended that EPA consider and seek comment on a wide range of regulatory alternatives to mitigate the impacts of the rulemaking on small businesses, including those flexibility options described below. As previously stated, the following discussion is a summary of the SBAR Panel recommendations; our proposals regarding these recommendations are located in earlier sections of this rule preamble.

i. Nonroad Diesel Engines

(a) Transition Flexibility Alternatives for Small Engine Manufacturers

The Panel recommended the following transition flexibilities to be considered, which were dependent upon what approach, or approaches, EPA proposes for the rulemaking.

- For an approach with two phases of standards:
    - an engine manufacturer could skip the first phase and comply on time with the second; or,
    - a manufacturer could delay compliance with each phase of standards.

- For an approach that entails only one phase of standards, the manufacturer could opt to delay compliance. The Panel recommended that the length of the delay be a three year period; the Panel also recommended that EPA take comment on whether this delay period should be two, three, or four years. Each delay would be pollutant specific (i.e., the delay would apply to each pollutant as it is phased in).

(b) Hardship Provisions for Small Engine Manufacturers

The Panel also recommended that two types of hardship provisions be extended to small engine manufacturers. These provisions are:

- For the case of a catastrophic event, or other extreme unforseen circumstances, beyond the control of the manufacturer that could not have been avoided with reasonable discretion (i.e. fire, tornado, supplier not fulfilling contract, etc.); and

- For the case where a manufacturer has taken all reasonable business, technical, and economic steps to comply but cannot do so.

Either relief provision would provide lead time for up to 2 years-- in addition to the transition flexibilities listed above-- and a manufacturer would have to demonstrate to the Agency's satisfaction that failure to sell the noncompliant engines would jeopardize the company's solvency. EPA could require that the manufacturer make up the lost environmental benefit through the use of programs such as supplemental environmental projects.

For the transition flexibilities listed above, the Panel recommended that engine manufacturers and importers must have certified engines in model year 2002 or earlier in order to take advantage of these provisions. Each manufacturer would be limited to 2500 units per year. This number allows for some market growth. The Panel recommended these provisions in order to prohibit the misuse of these transition provisions as a tool to enter the nonroad diesel market or to gain unfair market position relative to other manufacturers.

(c) Other Small Engine Manufacturer Issues

It was also recommended by the SBAR Panel that an averaging, banking, and trading (ABT) program be included as part of the overall rulemaking program, and, as discussed above, ABT has been included in the program.

During the SBREFA panel process several alternative approaches for engine standards were examined and considered by the panel. See Section 3.1.1 of the SBAR panel report. The SBA Chief Counsel for the Office of Advocacy also offered some observations about the impacts of the standards for engines less than 70 hp on affected small engine and equipment manufacturers which are based on the performance of PM or NOx advanced aftertreatment devices. While the other Panel members did not join in these observations, the Panel recommended that the Administrator carefully consider these points and examine further the factual, legal and policy questions raised here in developing the proposed rule. First, given the available information, the Office of Advocacy stated that they had substantial doubts about the technical feasibility and cost of engineering aftertreatment devices into a wide diversity of nonroad diesel applications for engines less than 70 hp. They stated that considerable concern has been raised regarding the technical feasibility of PM and NOx advanced aftertreatment devices, even for larger engines, and particularly in the case of NOx adsorbers. Second, the low retail cost and low annual production for many of these applications make it extremely difficult for the equipment manufacturer to absorb these additional costs. The Office of Advocacy believes that, based on the available information, the Agency does not have a sufficient basis to move forward with a proposal that would require nonroad engines under 70 hp to use aftertreatment devices. Based on the SERs' concerns about the technical feasibility of the Tier 4 standards, and the technical information discussed in the Panel report, SBA recommended that we include a technological review of the standards in the 2008 time frame in the rulemaking proposal. The Panel recommended that we consider this recommendation.

The SBA Office of Advocacy stated that considerable concern has been raised regarding the technical feasibility of PM and NOx aftertreatment devices, particularly in the case of NOx adsorbers. As explained in the preamble, we have found no factual basis for this statement with respect to PM controls based on use of advanced aftertreatment for engines between 25 and 75 hp.

We are not proposing standards based on performance of advanced aftertreatment for engines under 25 hp, and for NOx, for engines 75 hp and under.

With respect to the PM standards for these engines, however, EPA disagrees with the statement made by the Office of Advocacy that, based on available information, we do not have a sufficient basis to move forward with this proposed rulemaking requiring nonroad engines under 70 hp to use aftertreatment devices. As we have documented in the preamble and elsewhere in this Draft RIA, EPA believes that the standards for PM for engines in these power ranges are feasible at reasonable cost, and will help to improve very important air quality problems, especially by reducing exposure to diesel PM and by aiding in attainment of the PM 2.5 National Ambient Air Quality Standards (NAAQS). Indeed, given these facts, EPA is skeptical that an alternative of no PM standards for these engines would be appropriate under section 213 (a) (4). Moreover, the statement regarding cost impacts fails to account for transition flexibilities provided all equipment manufacturers as part of the proposal.

Further discussion of alternative engine standards below 75 hp can be found in Section VI of this preamble and Chapter 11 and 12 of the draft RIA, specifically the discussion of Options 5a and 5b. EPA invites comment on these specific small engine alternatives, as well as all other alternative options discussed in Section VI of this preamble. We invite comments specifically on the costs of using advanced aftertreatment devices, particularly on engines below 75 hp.

ii. Nonroad Diesel Equipment

(a) Transition Flexibility Alternatives for Small Equipment Manufacturers

The Panel recommended that EPA propose to continue the transition flexibilities offered for the Tier 1 and Tier 2 nonroad diesel emission standards, as set out in 40 CFR 89.102, with some potential modifications. The recommended transition flexibilities are:

- Percent-of-Production Allowance: Over a seven model year period, equipment manufacturers may install engines not certified to the new emission standards in an amount of equipment equivalent to 80 percent of one year’s production. This is to be implemented by power category with the average determined over the period in which the flexibility is used.

- Small Volume Allowance: A manufacturer may exceed the 80 percent allowance in seven years as described above, provided that the previous Tier engine use does not exceed 700 total over seven years, and 200 in any given year. This is limited to one family per power category. Alternatively, at the manufacturer’s choice by hp category, a program that eliminates the “single family provision” restriction with revised total and annual sales limits as shown below:

    - For categories ≤175 hp - 525 previous Tier engines (over 7 years) with an annual cap of 150 units (these engine numbers are separate for each hp category defined in the regulations)

- For categories of > 175hp - 350 previous Tier engines (over 7 years) with an annual cap of 100 units (these engine numbers are separate for each hp category defined in the regulations)

The Panel recommended that EPA seek comment on the total number of engines and annual cap values listed above. Specifically, the SBA and OMB Panel members recommended that EPA seek comment on implementing the small volume allowance (700 engine provision) for small equipment manufacturers without a limit on the number of engine families which could be covered in any hp category.

- In addition, due to the changing nature of the technology as the manufacturers transition from Tier 2 to Tier 3 and Tier 4, the Panel recommended that the equipment manufacturers be permitted to borrow from the Tier3/Tier 4 transition flexibilities for use in the Tier 2/Tier 3 time frame.

To maximize the likelihood that the application of these transition provisions will result in the availability of previous Tier engines for use by the small equipment manufacturers, the Panel recommended that these three provisions be provided to all equipment manufacturers. As explained earlier in the preamble, this is essentially the approach that EPA is proposing.

(b) Hardship Provisions for Small Equipment Manufacturers

The Panel also recommended that two types of hardship provisions be extended to small equipment manufacturers. These are generally the same as provided above for small engine manufacturers:

- For the case of a catastrophic event, or other extreme unforseen circumstances, beyond the control of the manufacturer that could not have been avoided with reasonable discretion (i.e. fire, tornado, supplier not fulfilling contract, etc.); and

- For the case where a manufacturer has taken all reasonable business, technical, and economic steps to comply but cannot. In this case relief would have to be sought before there is imminent jeopardy that a manufacturer’s equipment could not be sold and a manufacturer would have to demonstrate to the Agency’s satisfaction that failure to get permission to sell equipment with a previous Tier engine would create a serious economic hardship. Hardship relief of this nature cannot be sought by a manufacturer which also manufactures the engines for its equipment.

Hardship relief would not be available until other allowances have been exhausted. Either relief provision would provide additional lead time for up to 2 model years based on the circumstances, but EPA could require recovery of the lost environmental benefit. To be eligible for the hardship provisions listed above (as well as the flexibilities detailed above), the Panel recommended that equipment manufacturers and importers must have reported equipment sales using certified engines in model year 2002 or earlier. This requirement is to prohibit the misuse of these flexibilities as a loophole to enter the nonroad diesel equipment market or to gain unfair market position relative to other manufacturers.

iii. Nonroad Diesel Fuel Refiners

(a) Regulatory Flexibility Alternatives for Diesel Fuel Refiners

The Panel considered a range of options and regulatory alternatives for providing small refiners with flexibility in complying with new sulfur standards for nonroad diesel fuel. Taking into consideration the comments received on these ideas, as well as additional business and technical information gathered about potentially affected small entities, the Panel recommended that whether EPA proposes a one-step or a two-step approach, EPA should provide for delayed compliance for small refiners as shown below.

SMALL REFINER OPTIONS UNDER 2-STEP NONROAD DIESEL BASE PROGRAMS RECOMMENDED SULFUR STANDARDS (IN PARTS PER MILLION (PPM))[a]

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015+
Under 2-Step Program										
Non-Small[b]	--	500	500	500	15	15	15	15	15	15
Small	**--**	**--**	**--**	**--**	**500**	**500**	**500**	**500**	**15**	**15**

Notes:
[a] New standards are assumed to take effect June 1 of the applicable year.
[b] Assumes 500 ppm standard for marine + locomotive fuel for non-small refiners for 2007 and later and for small refiners for 2010 and later.

(b) Small Refiner Incentives for Early Compliance

In addition to these standards, the Panel recommended that EPA propose certain transition provisions to encourage early compliance with the diesel fuel sulfur standards. The Panel recommended that EPA propose that small refiners be eligible to select one of the two following options:

- Credits for Early Desulfurization: The Panel recommended that the Agency propose, as part of an overall trading program, a credit trading system that allows small refiners to generate and sell credits for nonroad diesel fuel that meets the small refiner standards earlier than that required in the above table. Such credits could be used to offset higher sulfur fuel produced by that refiner or by another refiner that purchases the credits.

- Limited Relief on Small Refiner Interim Gasoline Sulfur Standards: The Panel recommended that a small refiner producing its entire nonroad diesel fuel pool at 15 ppm sulfur by June 1, 2006, and that chooses not to generate nonroad credits for its early compliance, receive a 20 percent relaxation in its assigned small refiner interim gasoline sulfur standards. However, the Panel recommended that the maximum per-gallon sulfur cap for any small refiner remain at 450 ppm.

(c) Refiner Hardship Provisions

The Panel recommended that EPA propose refiner hardship provisions modeled after those established under the gasoline sulfur and highway diesel fuel sulfur program (see 40 CFR 80.270 and 80.560). Specifically, the Panel recommended that EPA propose a process that, like the hardship provisions of the gasoline and highway diesel rules, allows refiners to seek case-by-case approval of applications for temporary waivers to the nonroad diesel sulfur standards, based on a demonstration to the Agency of extreme hardship circumstances. This provision would allow domestic and foreign refiners, including small refiners, to request additional flexibility based on a showing of unusual circumstances that result in extreme hardship and significantly affect the ability of the refiner to comply by the applicable date, despite its best efforts.

iv. Nonroad Diesel Fuel Distributors and Marketers

The diesel fuel approach being considered by the Agency includes the possibility of there being two grades of nonroad diesel fuel (500/15 ppm) in the market place for at least a transition period. The distributors support a one-step approach because it has no significant impact on their operations. The distributors offered some suggestions on how they might deal with this issue, but indicated that there would be adverse impact in some circumstances. The Panel recommended that EPA study this issue further. The costs and related issues relevant to fuel distributors are further discussed in Chapter 7 of the proposed rule Regulatory Impact Analysis.

EPA invites comments on all aspects of the proposal and its impacts on the regulated small entities.

D. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law. 104-4, establishes requirements for federal agencies to assess the effects of their regulatory actions on state, local, and tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "federal mandates" that may result in expenditures to state, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective, or least burdensome alternative if the Administrator publishes with the final rule an explanation of why that alternative was not adopted.

Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

This rule contains no federal mandates for state, local, or tribal governments as defined by the provisions of Title II of the UMRA. The rule imposes no enforceable duties on any of these governmental entities. Nothing in the rule would significantly or uniquely affect small governments.

EPA has determined that this rule contains federal mandates that may result in expenditures of more than $100 million to the private sector in any single year. EPA believes that the proposal represents the least costly, most cost-effective approach to achieve the air quality goals of the rule. The costs and benefits associated with the proposal are discussed above and in the Draft Regulatory Impact Analysis, as required by the UMRA.

E. Executive Order 13132: Federalism

Executive Order 13132, entitled "Federalism" (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications." "Policies that have federalism implications" is defined in the Executive Order to include regulations that have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

Under Section 6 of Executive Order 13132, EPA may not issue a regulation that has federalism implications, that imposes substantial direct compliance costs, and that is not required by statute, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments, or EPA consults with State and local officials early in the process of developing the proposed regulation. EPA also may not issue a regulation that has federalism implications and that preempts State law, unless the Agency consults with State and local officials early in the process of developing the proposed regulation.

Section 4 of the Executive Order contains additional requirements for rules that preempt State or local law, even if those rules do not have federalism implications (i.e., the rules will not have substantial direct effects on the States, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government). Those requirements include providing all affected State and local officials notice and an opportunity for appropriate participation in the development of the regulation. If the preemption is not based on express or implied statutory authority, EPA also must consult, to the extent practicable, with appropriate State and local officials regarding the conflict between State law and Federally protected interests within the agency's area of regulatory responsibility.

This proposed rule does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132.

Although Section 6 of Executive Order 13132 does not apply to this rule, EPA did consult with representatives of various State and local governments in developing this rule. EPA has also consulted representatives from STAPPA/ALAPCO, which represents state and local air pollution officials.

In the spirit of Executive Order 13132, and consistent with EPA policy to promote communications between EPA and State and local governments, EPA specifically solicits comment on this proposed rule from State and local officials.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

Executive Order 13175, entitled "Consultation and Coordination with Indian Tribal Governments" (65 FR 67249, November 6, 2000), requires EPA to develop an accountable process to ensure "meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications."

This proposed rule does not have tribal implications as specified in Executive Order 13175. This rule will be implemented at the Federal level and impose compliance costs only on engine manufacturers and ship builders. Tribal governments will be affected only to the extent they purchase and use equipment with regulated engines. Thus, Executive Order 13175 does not apply to this rule. EPA specifically solicits additional comment on this proposed rule from tribal officials.

G. Executive Order 13045: Protection of Children from Environmental Health and Safety Risks

Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks" (62 FR 19885, April 23, 1997) applies to any rule that (1) is determined to be "economically significant" as defined under Executive Order 12866, and (2) concerns an environmental health or safety risk that EPA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, Section 5-501 of the Order directs the Agency to evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

This proposed rule is not subject to the Executive Order because it does not involve decisions on environmental health or safety risks that may disproportionately affect children.

The effects of ozone and PM on children's health were addressed in detail in EPA's rulemaking to establish the NAAQS for these pollutants, and EPA is not revisiting those issues here. EPA believes, however, that the emission reductions from the strategies proposed in this rulemaking will further reduce air toxic emissions and the related adverse impacts on children's health.

H. Executive Order 13211: Actions that Significantly Affect Energy Supply, Distribution, or Use

This rule is not a "significant energy action" as defined in Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use" (66 Fed. Reg. 28355 (May 22, 2001)) because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. If promulgated, this proposed rule would decrease fuel production by less than 4000 barrels per day and would increase fuel production costs, distribution costs, and prices by less than ten percent. The reader is referred to Section V above for the estimated cost, price and production impacts of the proposed fuel program.

I. National Technology Transfer Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 ("NTTAA"), Public Law 104-113, section 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless doing so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This proposed rule involves technical standards. The following paragraphs describe how we specify testing procedures for engines subject to this proposal.

The International Organization for Standardization (ISO) has a voluntary consensus standard that can be used to test nonroad diesel engines. However, the current version of that standard (ISO 8178) is applicable only for steady-state testing, not for transient testing. As described in the Draft Regulatory Impact Analysis, transient testing is an important part of the proposed emission-control program for these engines. We are therefore not proposing to adopt the ISO procedures in this rulemaking.

EPA welcomes comments on this aspect of the proposed rulemaking and, specifically, invites the public to identify potentially applicable voluntary consensus standards and to explain why such standards should be used in this regulation.

J. Plain Language

This document follows the guidelines of the June 1, 1998 Executive Memorandum on Plain Language in Government Writing. To read the text of the regulations, it is also important to understand the organization of the Code of Federal Regulations (CFR). The CFR uses the following organizational names and conventions.

Title 40—Protection of the Environment
- Chapter I—Environmental Protection Agency
  - Subchapter C—Air Programs. This contains parts 50 to 99, where the Office of Air and Radiation has usually placed emission standards for motor vehicle and nonroad engines.
  - Subchapter U—Air Programs Supplement. This contains parts 1000 to 1299, where we intend to place regulations for air programs in future rulemakings.
    - Part 1039—Control of Emissions from New Nonroad Compression-ignition Engines. Most of the provisions in this part apply only to engine manufacturers.
    - Part 1065—General Test Procedures for Engine Testing. Provisions of this part apply to anyone who tests engines to show that they meet emission standards.
    - Part 1068—General Compliance Provisions for Engine Programs. Provisions of this part apply to everyone.

Each part in the CFR has several subparts, sections, and paragraphs. The following illustration shows how these fit together.

Part 1039
- Subpart A
  - Section 1039.1
    - (a)
    - (b)
      - (1)
      - (2)
        - (i)
        - (ii)

A cross reference to §1039.1(b) in this illustration would refer to the parent paragraph (b) and all its subordinate paragraphs. A reference to "§1039.1(b) introductory text" would refer only to the single, parent paragraph (b).

XI. Statutory Provisions and Legal Authority

Statutory authority for the engine controls proposed today can be found in sections 213 (which specifically authorizes controls on emissions from nonroad engines and vehicles), 203 - 209, 216 and 301 of the CAA, 42 U.S.C. 7547, 7522, 7523, 7424, 7525, 7541,7542, 7543, 7550 and 7601.

Statutory authority for the proposed fuel controls is found in sections 211 (c) and 211 (i) of the CAA, which allow EPA to regulate fuels that either contribute to air pollution which endangers public health or welfare or which impair emission control equipment which is in general use or has been in general use. 42 U.S.C. 7545 (c) and (i). Additional support for the procedural and enforcement-related aspects of the fuel controls in the proposed rule, including the record keeping requirements, comes from sections 114 (a) and 301 (a) of the CAA. 42 U.S.C. sections 7414 (a) and 7601 (a).

List of Subjects
40 CFR Part 69
Environmental protection, Air pollution controls.

40 CFR Part 80
Fuel additives, Gasoline, Imports, Labeling, Motor vehicle pollution, Penalties, Reporting and recordkeeping requirements.

40 CFR Part 89
Environmental protection, Administrative practice and procedure, Confidential business information, Imports, Labeling, Motor vehicle pollution, Reporting and recordkeeping requirements, Research, Vessels, Warranties.

40 CFR Part 1039
Environmental protection, Administrative practice and procedure, Confidential business information, Imports, Labeling, Motor vehicle pollution, Reporting and recordkeeping requirements, Research, Vessels, Warranties.

40 CFR Part 1065
Environmental protection, Administrative practice and procedure, Incorporation by reference, Reporting and recordkeeping requirements, Research.

40 CFR Part 1068
Environmental protection, Administrative practice and procedure, Confidential business information, Imports, Motor vehicle pollution, Penalties, Reporting and recordkeeping requirements, Warranties.

Dated: ______________________

ORIGINAL SIGNED BY
CHRISTINE TODD WHITMAN, APRIL 15, 2003

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Christine Todd Whitman, Administrator